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An Investigation into the Introduction of Microcomputers
into Four Primary Schools.

Steven Terry Russell.

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An Investigation into the Introduction of Microcomputers into Four Primary schools.

Steven Terry Russell.

Abstract.

During 1982, the government supplied finance to primary schools for the purchase of one microcomputer system. This investigation focused on the organization and management of the computer system (and extra hardware purchased) in four primary schools. Also under investigation was the application of the computer in the classroom.

The four schools were severely hampered by the minimal amount of hardware available to them. This limitation affected individual teacher choice of software for use with pupils. Also, the introduction of the computer did not occur in parallel with a central in-service initiative.

County guidelines for the use of microcomputers in primary schools were introduced two years after the microcomputers were bought, illustrating the point that county were not aware of the potential use of the computer at the time of introduction. Ultimately, such guidelines from county bore little relation to what was actually happening in the classroom.

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Chapter 1

Introduction

During the Summer, 1982, the researcher became interested in the applications of microcomputers in primary schools. He decided to approach Middlesex Polytechnic in order to discuss the possibility of conducting case study research into the uses of microcomputers in primary schools. His original intention was to undertake an evaluation of the learning processes of a group of children who had access to a microcomputer, and compare these processes with the development of a control group, who did not have such access.

He contacted a local primary school which was known to him, and discussed the possibility of such research with the headteacher. She welcomed any involvement from the researcher.

From January, 1983, he changed employment, to take up a position at Hamble Technical College (1). Hamble is a new town situated in one of the home counties in the south of England. This change of employment was to mark the beginning of a complete change in emphasis in the nature of the research.

Primary schools in the Hamble area received their government sponsored computers under the 'Micros in Schools' scheme, during the summer, 1983. The 'Micros in Schools' scheme was a government initiative which supplied

Note 1 Names of schools, college and teachers are fictitious

primary and secondary schools with half the cost of one microcomputer system comprising of a microcomputer, monitor and cassette recorder, to load programs. The County Advisory Service had not arranged in-service courses to introduce teachers to possible applications of microcomputers alongside this introduction of hardware so the researcher decided to investigate the possibility of providing such a programme at Hamble College.

After consultation with the L.E.A Inspectorate, the programme was initiated. It was as a result of this programme, which gave the researcher access to many schools in the local area, that the researcher changed the nature of his investigation. Teachers attending these in-service courses were to highlight the importance of what amounted to the beginning of primary school computing, particularly the organizational aspects of implementing computers in schools. He decided to investigate the curriculum implications of using microcomputers in four schools, rather than concentrating on the learning processes of a small group of children. Conducting research in four schools enabled the researcher to contrast the implementation of microcomputers in the four schools, which were different in several ways. As the research progressed, however, the introductory aspect (of microcomputers in primary schools) became increasingly important. The access to schools at this particular time provided a unique opportunity to document the introduction of microcomputers into four primary schools and describe the decisions

teachers made which may have implications for the future. His focus therefore moved away from the curriculum towards the organizational and management aspects associated with the introduction. The thesis, however, does include comments and implications for the curriculum as developed throughout the introductory period.

The research was to last for a period of five terms, September, 1983 to Easter, 1985. He decided on this length of time because it enabled him to return to the schools during the summer term, 1985, for discussion with teachers where necessary. If he had used this term for research, there would have been a summer holiday break and the research would not have been fresh in the teachers' minds (nor, indeed, the researcher's). Although the research was of four primary schools, it should be noted that one of the schools was involved in the research for only one academic year, since they received their computer system one year late.

As the research progressed, the researcher had considerable difficulty linking the in-service section of the research, (taking place at Hamble Technical College), with the case-study research, being conducted in the four schools. He established a link between these two distinct parts of the research- that of the common element relating the two- the fact that both came about as a result of the introduction of microcomputers into primary schools. It was as a result of this introduction that the two main strands of the research were brought together.

The three aims of the research were as follows:

For the researcher to investigate:

1. The organisational and management aspects of the introduction of microcomputers into primary schools.
2. The detailed application of the computer.
3. The changing nature of his function in the monitoring of the introductory process.

There are a number of both computing and educational terms used throughout this thesis. A glossary of these terms is contained in appendix 1.

Chapter 2

Background to the research

The literature concerning microcomputers and primary schools has tended to centre around both the problems of introducing microcomputers into schools and the use made of them once they are installed. This literature survey concentrates on three main areas of information and knowledge:

1. The introduction of microcomputers into primary schools, and the involvement of the 'Micros in Schools' scheme and the Microelectronics Education Programme.
2. Curriculum considerations involving microcomputers and primary schools.
3. The type and application of software available to schools at the time of the introduction of microcomputers.

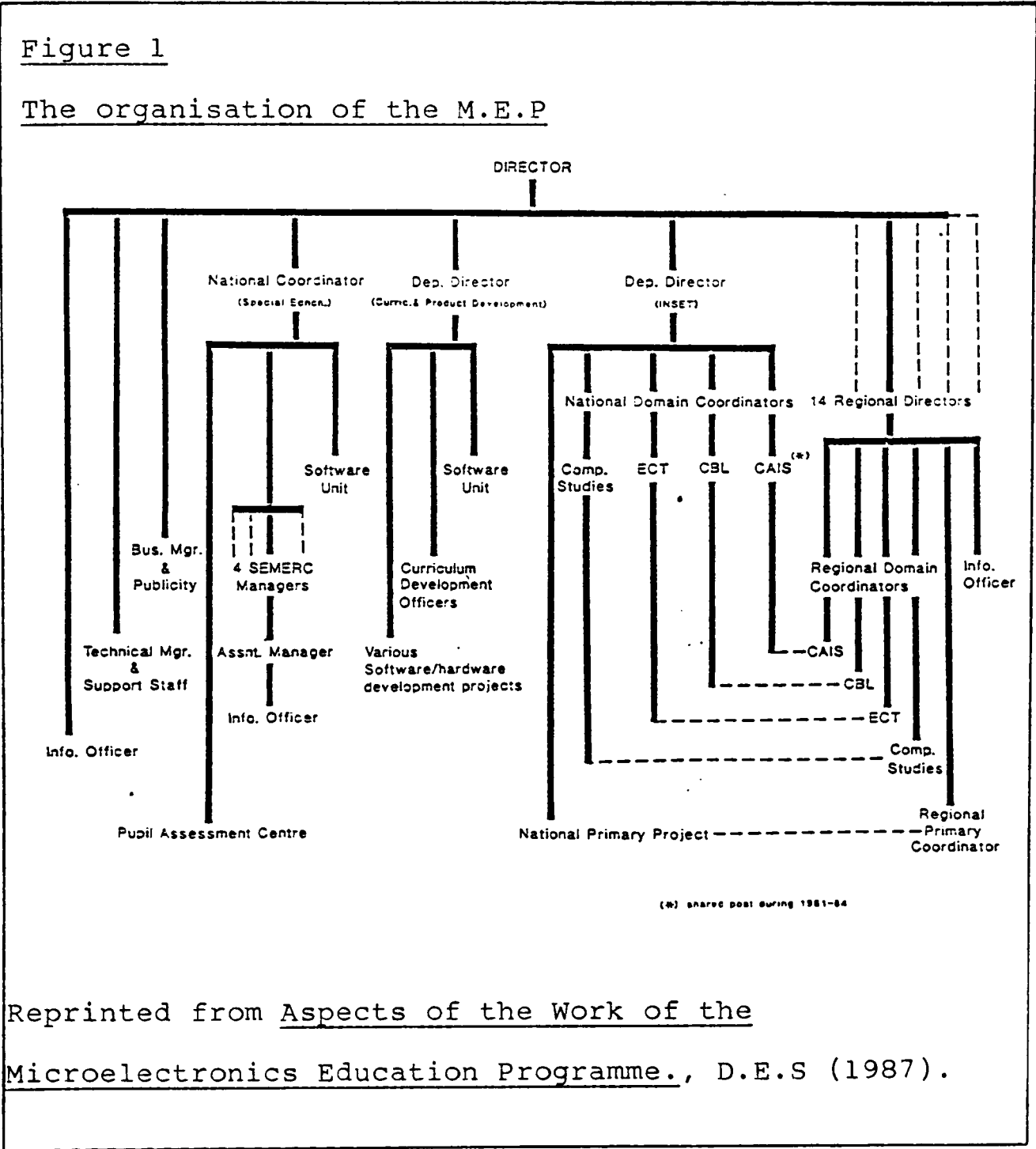
The introduction of microcomputers into primary schools.

The 'Micros in Schools' scheme was announced by the Government in 1981. 50% of finance was supplied by the Department of Trade and Industry to enable all secondary schools to buy a microcomputer system. By 1983, the scheme was extended to include primary schools.

The initiation of this research coincided with the extension of the 'Micros in Schools' scheme to primary schools.

At about the same time, the Microelectronics Education Programme, (M.E.P), was set up to assist in the implementation of the equipment in schools. The work of the programme involved such areas as in-service training

provision, software development, curriculum development, and the sponsoring of specialized projects relating to their brief. The M.E.P played a considerable part in the development of material to assist practitioners in the implementation of the equipment in the classroom. Figure 1 illustrates the organisational framework of the M.E.P:



Note 2. Names of computer programs are in capitals throughout the thesis

The M.E.P developed the MICROPRIMER software. This was the software which was supplied to all schools with their sponsored computer system under the 'Micros in Schools' scheme. The software provided a starting point for all schools and was based on what the M.E.P decided was useful to schools at the time of introduction. Such an initiative provided evidence of an implicit curriculum control element, through software, in the introduction of the computer.

O'Shea and Self (1983), distinguished between the 'Micros in Schools' scheme and the M.E.P and suggested that the latter were hampered by the decision made by the 'Micros in Schools' scheme to give LEA's a choice between three computers which had little available software. Moreover, they suggested that the 'Micros in Schools' scheme made no reference to the application of the computer in the classroom, which was the basic role of the M.E.P, through teacher training and software development. The two organisations appeared to be disjoint:

" The 'Micros in Schools' Scheme does not address the two problems which will determine the success or otherwise of the MEP: the shortage of teachers trained in the new technology and of good educational software. Hastily acquired equipment which cannot be used effectively may well be left idle, to become obsolete."

Towards the end of its life, the M.E.P established itself as something of an authority on software applicable to schools. Its logo has often been used on software to indicate that such material has 'M.E.P approval'.

Garland (1983), referred to the introduction of

microcomputers into primary schools as a 'fresh phenomenon' and more generally as a technological innovation, different to other innovations because of the enormous range of tasks a computer can undertake. The researcher felt that it was pertinent to initiate a research programme in the light of this 'fresh phenomenon', so as to provide a directional framework for practitioners. Such an approach can be found in Young (1965), who suggested that innovation and research should be closely linked in order to assess the justification for implementing an innovation. He also pointed out that change frequently occurs in education, often as the result of fashion rather than research. By this, he implied that the introduction of an innovation does not always occur as a result of an appreciation of its educational worth and application, but often as a result of a trend in society. In recent years, computers have been applied throughout society, commercially and for leisure. This trend has now reached the primary schools. Sage and Smith (1983), discussed the work of both the M.E.P, and the original 'Micros in Schools' initiative from a similar viewpoint to Young:

"The above programmes have all been concerned with the injection of technology into the educational scene, the means by which it can be used quickly and the development of educational materials. In the latter context, the technology has been applied in a manner which to a large extent simulates traditional methods and practices. None of these programmes have been concerned with fundamental educational issues or the development of that understanding which is so essential to the successful utilisation of any new technology within education and the appropriate evolution of the curriculum."

They also discussed the need for illuminative research, in the hope that teachers will benefit:

" It is considered that there are grounds for case studies of a relatively small number of schools. Such studies might be expected to contribute to our understanding of curriculum diffusion processes, and should also provide practising teachers with aids to the analysis of their own problems."

The M.E.P strategy document, DES (1981), made no mention of research as part of its brief, and only referred to curriculum development projects which were substantially regional projects to 'build on the foundations of existing work by teachers and LEA advisers and promote the cross fertilisation of ideas between one authority and another'. The Chiltern Logo Project, Noss (1984a), was an example of this, and is discussed later.

Avis (1986), an M.E.P regional director, described the M.E.P as being an experimental programme operating at differing levels. Moreover, he suggested that the M.E.P failed to achieve sufficient penetration in the classroom. Davies (1982), argued that it is within the classroom that curriculum development occurs, through a model similar to that of Stenhouse (1975), a model of curriculum development which involves teachers being researchers in their own classrooms. This model focuses on the teacher as the central figure in curriculum development. Within this framework, evidence has suggested that the stated lack of M.E.P penetration into the classroom has hampered its curriculum development support work. This researcher

suggests that such support work could have been more successful if founded within a framework of research.

Hubbard (1986), discussed the initial construction of the M.E.P, and highlighted areas which have probably contributed to its overall effectiveness:

"If it sometimes seemed that M.E.P was in too much of a hurry to work things out properly, always in crisis, never able to take a long view, the reason is that it was, and the fault lay in that absurd time scale, five years reduced to four, with one squandered (not totally of course, some of the first year activity was very valuable, but it was pure chance if it contributed to the overall Programme) and then a further two added."

He concluded that:

"The time-scale of innovation is not short. Five years is the very least time for any development, and usually much longer is needed. Short programmes which are then extended, (as was the M.E.P), are not as effective as programmes which are the right length to start with."

A D.E.S report entitled Aspects of the Work of the Microelectronics Education Programme, D.E.S (1987), reinforced Hubbard's view by suggesting that the nature of the M.E.P funding may have contributed to its overall success:

"The fact that MEP's funding was on an annual basis, and that some funds would be entirely lost if they were not allocated to projects or personnel before the end of a financial year, sometimes increased the need for speed. This was not always helpful to the planning of sound educational programmes."

It must be remembered that the primary sector of education entered into the government scheme towards the end of the scheme's life- both secondary and further education were initially involved. Many primary schools

were receiving their computers as the scheme was finishing, and the M.E.P was nearing the end of its final extension. Under these circumstances, such schools were unlikely to receive much support from the M.E.P. Related to this point is the fact that there are more schools in the primary sector of education than in the other two, so hardware and software resources are likely to be fewer per school since such resources have to cover more institutions. This would appear to be the case. The 'Micros in Schools' scheme supplied half the funds for one microcomputer system. Two surveys have been published reporting the take up of microcomputers in primary schools. Jackson, Fletcher and Messer (1986), conducted a survey of primary schools during June 1984, in one local authority. One part of the survey was to investigate how many schools had purchased a microcomputer.

The second survey was conducted one year later by Bleach (1986). This was a postal survey conducted on a random sample of schools in England, Scotland and Wales. The results of both are illustrated in table 1:

Table 1		
The results of two surveys on numbers of computers		
Number of Computers	Number and % of Schools	
	Jackson	Bleach
0	187 (44%)	31 (6%)
1	162 (38%)	295 (58%)
2	60 (14%)	117 (23%)
3 or more	17 (4%)	66 (13%)
Total	426 (100%)	509 (100%)

Bleach concluded that:

"Lack of hardware generally, including trolleys and disc drives, was seen as having a detrimental effect. Many schools indicated that their positions would be much improved with more computers and this is certainly born out by the appalling pupil:micro ratios, with over half the schools sharing machines between 100 or more users. Both in numbers of micros and amounts of use made of them, small schools and those catering for younger children fared worse. Since 86% of schools had acquired their computers as a result of the government's offer one can only speculate that, without this subsidy, only a very small percentage would now have computers. Some schools had obviously moved on and funded further machines themselves but 58% of schools still only had one computer."

The computer is still a scarce resource in primary schools. The scarcity of equipment has implications for both the management of the equipment and how it is used in schools. The effect of this is that management problems incurred through a lack of sufficient resourcing are reflected in the ultimate effect of the computer on the curriculum. This point is illustrated through the two possible management approaches to the introduction of the computer. Firstly, if the computer is used solely by one class, then other classes have no use. Secondly, if the computer is timetable or shared between classes, each class has very little use. Whichever decision is taken, the curriculum is not affected by any considerable extent, except possibly in the first example with one class (the sole users). The initial momentum generated by the 'Micros in Schools' scheme and subsequently through the M.E.P seems to be subsiding. Now that both the 'Micros in Schools' scheme and the M.E.P have ceased to exist, it

seems unlikely that the situation will ever be as Noss (1984a), suggested it may- that of 'computer-rich' classrooms in the near future.

Smith (1984), suggested that the decision to purchase a computer system occurred in many cases as a result of financial inducement. Schools were given a 'hard to refuse' offer by the government, a subsidy of half the cost of a system. This reason for purchase, (i.e financial inducement) he suggested, should not be overlooked when evaluating the effectiveness of its use. In such cases, the acceptance of the offer was with reservations and possibly little knowledge of the possible uses of the computer. This was substantiated by the four headteachers of the schools taking part in this research. None had seen computers used in education before and all made the decision to by their computers not knowing of the applications which were to follow.

Curriculum considerations involving microcomputers and primary schools.

Dodds (1984), suggested that the microcomputer can contribute to the curriculum in three different ways:

1. Curriculum-centered uses, where a piece of software is used within a topic or project.
2. Curriculum innovation, where the computer can be used to introduce a new area into the curriculum, e.g computer programming.
3. Curriculum support, where the computer is used to aid specific areas, e.g drill and practice programs.

These three areas are also contained within the scope of the support work undertaken by the M.E.P.

Vincent (1984), developed a more global perspective on the applications of microcomputers in education. He discussed three traditional views regarding the educational uses of computers in schools as follows:

View 1: Computer Aided Learning (CAL). The use of the computer for systematic instruction in traditional subject areas.

View 2: A computer literacy view, where children become familiar with the uses and implications of Information Technology in society.

View 3: A secondary school view involving the restricted use of the computer in a computing department.

He developed a fourth view, which has come about as a result of the 'Micros in Schools' scheme. This view relates to the nature of the software packages being developed for primary schools. He described this emerging software as providing a learning environment for the child in which "speculative thinking can be put to the test". He mentioned Word Processing and Logo as examples of such software.

Wray (1984), described the nature of educational software as being either 'open' or 'closed' in nature. He suggested that 'closed' software leads "nowhere, and once the child has used them, there is little point in him or her using them again". His definition of 'open' software fits into Vincent's fourth view as being "a content- free

vehicle for many different kinds of work, like the word processor, or a stimulus for a great deal of creative work away from the computer, like adventure games". He continued to mention information retrieval as another piece of 'open' software.

The introduction of microcomputers into primary schools involved teachers in implementing the computer in the classroom. This was achieved through the use of both 'open' and 'closed' software. The researcher has investigated three particular applications of 'open-ended' software, Information Retrieval, Word Processing and Logo, the three subdivisions which provided the framework of his in-service programme discussed later. The Inspectorate of the researcher's L.E.A suggested to him that they believed 'open-ended' applications to be the most worthwhile applications of the microcomputer, hence such a review is particularly relevant to this study. The official county guidelines document produced by the Inspectorate entitled Topics and Centres of Interest in the Primary School. Using Microcomputers., County (1987), emphasised this point by making particular reference to the three types of 'open-ended' software:

" The computer has proved to be particularly useful in Environmental and Topic Work, and children have learned to use computer programs concerned with information retrieval....The use of the microcomputer as a word processor is achieving interesting results. It is useful for children to have an alternative means of developing their ideas and to be able to discuss and edit their writing before a final version is produced....LOGO is a computer language designed specifically to enhance learning. A

key feature of our schools' developing use of computers is that children should be in control of the machines rather than being programmed by them."

The county document made reference to two applications of the computer suggested by Taylor (1980). He had suggested that we think of the computer as tutor, tool, or tutee. In the tool role, the computer assists in doing something, in this case, topic work. In the tutee role, it is used as a device that can be 'taught', in this case, the use of Logo. The researcher has also investigated applications of 'closed' software, Taylor's reference to the tutor role, where the computer teaches directly. It was this type of software which was used frequently in the schools of this study, and is thus relevant to the research.

Open Software.

The three main categories of 'open-ended' software investigated by the researcher are Logo, Information Retrieval and Word Processing.

Logo

Logo is a computer programming language developed in the early 1960's by Seymour Papert. In 'Mindstorms', Papert (1980), he discussed the invention of Logo, and the implications of exposing the child to a Logo-like environment. He suggested that Logo can help children think logically, and develop mathematical concepts and problem solving skills. Moreover, he suggested that the way children develop these skills is different through Logo, largely because the child is creating and is in control of his own learning environment.

Much research centred on Logo has tended to be based within a framework of the child's mathematical development. This is hardly surprising since Logo was initially invented by Papert to develop and stimulate mathematical thought, through its program structure. Much research has concluded that Logo programming can develop certain mathematical concepts, Howe O'Shea and Plane (1979), Feurzeig et al (1969), Milner (1973). It must be remembered, however, that most of the above studies were conducted under deliberate, preconceived conditions, usually with small groups of children. Ross and Howe (1981), criticized such conditions as being artificial. They argued that such research is not linked closely

enough to what is occurring in the classroom, and tends to be isolated in nature.

Sutherland and Hoyles (1985a), researched Logo within the classroom, unlike many of the projects above. One observation of their research was that pairs of pupils developed their collaborative skills when using Logo. Also, the use of Logo was integrated into the existing mathematics curriculum. It should be noted, however, that Sutherland and Hoyles conducted their research in the secondary school. Nevertheless, their research represented a move away from the type of investigations criticized by Ross and Howe above. The results of such research must reflect an investigation which was conducted in a classroom, and must thus have relevance to classroom teachers. Also, the researchers were involved in collaboration with the classroom teachers- teachers were involved in the research. This further strengthens the relevance of such research to the teacher. It must be remembered, however, that the two classes observed in the Sutherland and Hoyles study had the use of two and four computers respectively. The results can thus only point the way to what is possible with Logo if such resources are made available.

Another example of classroom-based research into Logo is The Chiltern Logo Project, Noss (1984a). The Chiltern research involved five primary classrooms, each equipped with a computer, a floor turtle, a printer and a version of Logo. Also, teachers were introduced to Logo during the

first six weeks of the project. Noss (1984b), the director of the project, suggested that Logo has become more acceptable to primary schools than secondary schools as a result of the nature of the computer language. Also, he suggested that Logo can be more readily integrated into the primary school than the secondary school:

" First, there is the problem of integrating programming activities into the existing school curriculum. One of the reasons why Logo has so far been more readily accepted in primary rather than secondary schools is related to this. A primary classroom is often a place where literally dozens of different activities are going on at once... In the secondary school the problems are more acute. Which department should use it?..."

His observations of Logo were realized within a classroom context, in a similar way to those of Sutherland and Hoyles. A result of the research was that children's problem solving skills developed considerably as their knowledge of Logo increased. It should also be remembered that each class taking part in the project had sole use of one complete computer system. This amount of hardware is not usually exclusively available to one primary classroom. However, the Chiltern Logo Project provided useful guidelines for teachers wanting to explore the full capabilities of Logo, and not just the graphic facilities.

Wellington (1985), conducted research which suggested that Papert's claims that Logo changes the nature of the learning environment are largely unjustified and that children do find programming in Logo difficult, mainly because the top down approach to problem solving is too structured for them. He particularly argued that Papert's

claim that approaches to problem solving through Logo will transfer across to other areas of learning and thinking, are wholly unjustified, mainly because it is as difficult to disprove such an assumption as to prove it. He concluded that:

"Papert's claims for the transfer of learning need careful and systematic investigation before they can be believed. His broader claims for the pervasive cultural influence of educational computing also need to be examined carefully."

Wellington's research was conducted in a university environment with many computers and both initial and in-service students working with the children, so it is realistic to expect that his results may be different to results found within real classroom conditions.

McShane and Simon (1985), disputed the psychological claims made for Logo as being unsupported in the psychological literature on mechanisms of learning. Their argument was that the "learning-by-doing" approach to education, as suggested by Papert, has not been shown to be totally successful when adopted globally, and that structure has its place within the curriculum. Sutherland and Hoyles (1985b), reinforced this view by suggesting that the teacher's role is important in the use of Logo, through both the introduction of programming concepts, and the development projects. Hence, it is the teacher who is the provider and decision maker of the overall framework within which Logo activities should take place.

Ruthven (1984), regarded Papert's attitude to evaluation as "ambivalent", and suggested that the

learning environment created through Logo is actually quite limiting:

"Take Turtle geometry, for example. Papert suggests that identification with the Turtle enables children to relate their body-knowledge to learning formal geometry. Certainly Turtle geometry lends itself well to situations in which the objective is the formulation and representation of procedures, and in which there is a high degree of regularity and order. But geometry is also concerned with establishing and representing structural and logical relationships, and with situations which lack regularity; in either case, Turtle geometry tends to be a blunt-edged tool."

Logo is increasingly being criticised. More practitioners and researchers are aware of it than ever before, now that several versions are available for almost all microcomputers, and many schools have at least one version of it.

Information retrieval

Information Retrieval constitutes another computerized activity which slots into the category of 'open-ended' software, although little research has been conducted involving its application in schools. One possible explanation for this could be that there is little point to such research, since the process of a child, or group of children collecting information concerning a particular topic and entering it into a computer for later use, can be immediately seen as useful and desirable. Coupland (1983), related the use of an information retrieval package to project work:

" The techniques associated with information retrieval have long been considered appropriate for primary schools. Project work, in particular, involves searching for and collecting details from a variety of sources. These are then ordered and sorted whilst appropriate methods for recording and examination are discussed."

The D.E.S, in their document The Curriculum from 5 to 16, D.E.S (1985), made reference to Information Technology as being a desirable activity when applied to information retrieval and handling.

The M.E.P certainly intended information retrieval to be a useful activity for the primary school classroom, since such a package was contained in the initial MICROPRIMER software supplied to all schools. Also, most L.E.A'S have tended to sponsor a particular package for use in schools. The use of such a package is dependent on the child having information ready to be entered into the computer, and may well be information linked to a

classroom topic.

Ross (1984a), illustrated through a case study the use of an information retrieval package in the development of information handling skills with children in his class. Furthermore, he argued, (Ross 1984b), that the use of such packages can change the learning processes of the child. He suggested that such packages enable children to set up hypotheses and test them on the computer, which makes the hypotheses become real to the child. The ideas discussed by Ross could provide a framework for future research. His work, although hardly constituting research, provided a realistic, meaningful context for classroom teachers, since the conditions of his working environment were not specifically designed for the purposes of research.

The Hertingfordbury Project (1985), was set up to investigate data handling in the primary school. One observation from the project, Levett (1985), was that children were capable of establishing hypotheses and, by using the data handling computer program, deciding whether or not the results confirmed or denied their hypothesis. These observations were similar to those of Ross, although the framework within which the project was managed was favourable to a teacher with little confidence. Six primary schools were involved in the project. The project co-ordinator worked closely with the teachers concerned throughout the project, in effect giving more support than the standard classroom teacher could expect. The teachers' confidence in using the software increased as the project

progressed. (similar results emerged from the in-service programme part of the researcher's study). Teachers may feel that information retrieval is a worthwhile activity within the classroom, even though little of it has occurred. The main reason suggested by some teachers is that the relevant software available to implement such computer activity is too difficult to use, unless considerable in-service training is available. This theme was reinforced by Jackson, Fletcher and Messor (1986), in their study of Hertfordshire primary schools. They suggested that the more sophisticated software, tended to be used by teachers having attended a training course.

Word processing

Word Processing has similarities to information retrieval in that the use of such a package is dependent on the child having data to type into the computer. In the case of the word processor, data is in the form of text. Most LEA's tend to sponsor the use of one or two particular word processing packages in schools. Often, their reasons for sponsoring a particular package are related to the facilities contained within it, and make little or no reference to educational practice. To illustrate this point, Smith (1986), discussed the use of a word processing package with developing writers, and the power of such software to enable children to draft and re-draft written work. This educational application of the word processor does not make reference to a particular piece of software, but provides a framework for general

use in schools. Almost any word processor can be used for such a function. Also, she pointed to the danger of spending too much time using the facilities inherent in more sophisticated word processors to simply produce a tidy output:

" The danger of using the word processor to help with writing is that its use will only be confined to the secretarial function. That it will merely be an improved version of 'writing out in best'."

Trushell and Broderick (1984), investigated the use of editing facilities contained in word processors from a similar point of view. They suggested that children become less inhibited by being able to correct a piece of text immediately, and that they are more inclined to revise their composition.

Word processing is a time consuming activity, as are most applications of 'open-ended' software. The time taken for a child to type text into a word processor is dependent on the child's typing speed, which is often very slow. The ideal situation is where developing writers have a word processor at their disposal constantly. The situation in primary schools with regard to hardware resourcing does not lend itself to teachers achieving the results of the research discussed. The research discussed provides useful pointers for development in the primary school when hardware is more readily available.

Closed software

'Closed' software, sometimes known as subject specific or drill and practice software, did not have a reputable name by the beginning of the decade. Taylor (1982), criticised much software of this kind by suggesting it was written without reference to educational practice:

" It seems that most of this software has been written by programmers who know little about education, by educators who are not proficient programmers, and by opportunists who have sufficient expertise in neither programming nor education."

Schenk (1984), suggested that in many cases, such software does not demonstrate anything which cannot be equally well done by other means. Technically, he argued, it is very difficult to write a computer program which will accept every correct answer. He illustrated this through a particular MICROPRIMER program, as supplied to all schools through the M.E.P:

" For example, the program BRICKUP, distributed nationally as part of the MICROPRIMER series, invites a child to key in a word that starts with 'den' and means 'something to do with teeth'. If a child responds with 'dentist', rather than 'dental', the word the programmer expected, the error message comes up: 'Dentist' is spelled badly! At best such programs test rather than teach; most do so outside any meaningful context; at worst some will even fail to accept perfectly valid answers and penalise children for ingenuity and unorthodoxy."

Most of the initial MICROPRIMER software was subject specific, drill and practice material which seemed not to have been tested in schools before release. It differed

from the software mentioned by Taylor in that it was written by programmers and designed by educationalists, although, as illustrated above, with limited success. Also, the majority of drill and practice software has tended to be mathematically biased.

Many of the criticisms of the MICROPRIMER software were dealt with when a second batch of software was released by the M.E.P in the areas of language and mathematics. This software was free from the problems discussed above, and made greater reference to primary practice.

Straker (1984), discussed the application of various types of mathematics software, much contained in the MICROPRIMER material and subsequent M.E.P productions, with particular reference to the Cockroft Report. She suggested that there is much available which relates directly to the proposals put forward in the Cockroft Report, namely that mathematics teaching should be a balance between:

Practical work;

Exposition by the teacher;

Practice by the children;

Discussion between children, and teacher and children;

Problem solving, including applications;

Investigation.

However, although these aspects of mathematics teaching are displayed through various items of software, she suggested that the nature of the software is still generally moving in one direction:

" But in spite of the improvement in the amount of primary mathematics software, at present there is far more of one type than of all the other types put together. There is already an excess of drill and practice which simply present in a novel manner exercises which can also be presented quite adequately by other means. Although there are a growing number of good, strategic mathematical games, more are needed. The number of programs which stimulate discussion about mathematics, or which present appropriate problems and applications to primary children, is very small, and there is only a handful of programs which allow children to undertake mathematical activity at the computer in a truly investigative way."

Fletcher (1983), discussed the value of drill and practice mathematics software, and suggested that if administered carefully, can aid a child's mathematical development. Moreover, he suggested that the use of such software can aid the development of numerical skills, since such skills do require some measure of deliberate practice.

Jackson, et al (1986), reported in their survey of microcomputer usage that 57% of teachers used drill and practice software, and that mathematics was the most popular application (75%). Much drill and practice software can be used easily by teachers without the need for in-service training. They suggested that more in-service training and hardware resourcing is required if teachers are to move away from such software towards the more 'open-ended' software:

" It has often been argued that the most worthwhile use of the microcomputer lies with the more innovative software (e.g open-ended and data handling) where the locus of control

belongs more to the child rather than the program. The large number of publications concerned with Logo suggests that this is frequently used in primary schools. This survey shows that there is a disjunction between theory and practice as most teachers were found to use drill and practice software. However, frequency of use and attendance at training courses are associated with increased use of this more sophisticated software. This suggests that to draw teachers away from drill and towards child-centred programs, more attention must be paid to training and provision."

Summary

Research into microcomputers and curriculum development occurred after the 'Micros in Schools' scheme was introduced, as discussed by Sage and Smith (1983). Most research involving the uses of microcomputers in education has tended to focus on software, which can be 'open' or 'closed'. Although funds have been made available through the M.E.P for the development of suitable software, the educational relevance of such software is now being questioned- after the decision was taken centrally to introduce microcomputers into primary schools. Various localised projects have been funded by the M.E.P, but this has occurred after schools made the decision to purchase microcomputers. In short, the educational worth of the computer was relatively unknown in primary schools by teachers, headteachers, advisory bodies and educational researchers at the time of its introduction- such knowledge has developed after acquisition.

In the primary sector, teachers have tended to

introduce computers through 'closed' software, (Jackson, et al 1986), and usually progress to the more 'open-ended' software as a result of in-service training or after a period of familiarisation. (This trend is substantiated by the researcher through his own in-service programme, which has produced similar results).

Logo was invented twenty five years ago. Since then, research involving Logo has tended to be laboratory based, where children are extracted from the ordinary classroom situation in order to take part in an investigation. A move away from such laboratory conditions is apparent in current research, where case-studies have been set up, and research has been conducted in the actual classroom. However, the findings of such research must be related to the substantial hardware resourcing usually made available to the classes taking part in these studies, resourcing which is not usually available to the average classroom. This type of research has its foundations within an action research framework, (similar to this research). It provides valuable information for teachers on what may be achieved when above normal hardware resources and in-service training are available.

Word processing packages can play a valuable part in the process of drafting and re-drafting composition, and research is beginning to emerge involving the use of word processing packages as educational tools to stimulate such development, as well as investigations into assessments of language development when such software is implemented,

e.g Baskerville (1984).

'Open-ended' software does not always produce immediate results for children. Entering data into an information retrieval package, typing text into a word processing package can take a considerable time, as indeed can the training necessary to use such a package initially. This time is not always available in the primary school with limited hardware and few local in-service training courses. Some teachers gain confidence when attending in-service training courses, confidence which may be reflected in their classroom management by enabling children to have more 'time on task' with the computer.

Meaningful research into the applications of microcomputers in primary schools, (i.e research to which a teacher can relate), needs to be extended. A method of achieving this is for research to focus not only on the teacher but where the teacher is a collaborating partner with a research co-ordinator. Such research has been undertaken in the area of in-service collaboration, for example, Rudduck (1982). It is suggested that current research into the educational uses of the computer is moving this way, through several types of classroom research which have already occurred. The theme of this chapter has been the contrast between the applications of the microcomputer after its initial introduction into primary education and the limited amount of resourcing available to schools. Extending research in the way described above will inevitably embrace the existing

hardware and software situation of schools and provide useful research within a classroom context.

Chapter 3

Methodology

"Case study research should be of benefit and interest to those people who are studied.....Case study research should be directed to improving the capacity of those who are studied to do their job." Stenhouse (1981).

The form of the investigation's methodology was basically case-study. The researcher's initial aim was to find four schools in the Hamble area, with headteachers interested in an investigation into the uses they made of computers. The schools approached by the researcher were deliberately chosen to contrast each other in size, and were geographically situated near each other. Table 2 illustrates the relevant school data:

Table 2 Details of school staff and number of classes.				
Name of School	Research Collaboration		No. of staff (inc. head)	No of classes/pupils
	Yr 1.	Yr 2.		
1. Sunhill C. of E. County Prim. School	YES	YES	3	3 (70+ Pupils)
2. Middleton County Prim. School	YES	YES	9	8 (240+ Pupils)
3. Keeble County Prim. School	NO	YES	15	14 (300+ Pupils)
4. Monkham County Prim. School	YES	YES	6	5 (150+ Pupils)
Note. Keeble did not take part in the first year of the research because their computer did not arrive.				

By choosing two similar schools, approaches to computer implementation could be observed and ultimately analysed by the researcher, whereas the contrasting sizes of the other two schools enabled the researcher to investigate the implications of supplying one microcomputer system to each school, irrespective of size. A lack of hardware resources was to ultimately be of great concern for the large school.

Having contacted the schools concerned, it was immediately obvious to the researcher that the four headteachers welcomed such research. Without exception, the four headteachers had no preconceptions about the impact of microcomputers in their respective schools. Their reasons for purchasing the equipment are discussed elsewhere, but it was to be the case that both help and advice were needed regularly, particularly when technical problems occurred.

The Case for Classroom Based Research.

A case-study approach was adopted by the researcher for three main reasons. Firstly, the introduction of microcomputers into primary schools occurred at a time when teachers had little idea regarding the uses to which

Note 3. Monkham was chosen when an original school withdrew, and was in a different county. Consequently, all references to county refer to the county of the other three schools.

they were going to put the computers. A small scale case study was seen by the researcher as a vehicle for illuminating the problems (and solutions) involved in the implementation of an innovation, and the methods employed by schools to integrate both the hardware and software into the school curriculum.

Secondly, the Schon Centre-Periphery model of social change provided the conceptual framework for this research. This particular model was initially used in relation to economic growth. Consequently, it was seen as pertinent to view the School as a complex 'Total' institution, using Goffman's (1961) criteria. With these considerations, a case-study approach could shed light on the complexities of pupil - teacher - researcher - computer interaction and possibly provide guidelines for the future.

Thirdly, the time of the mass introduction of microcomputers into primary schools was never to occur again. This research was to provide historical documentation of this introduction and through its case study methodology would provide useful information for the introduction of future innovations. The usefulness of the research to the teacher was of paramount importance to the researcher. He perceived the teacher as a central, active participant in the research. It was always important for the researcher to constrain the research within a framework which was relevant to the teacher, and not to produce research which was outside the consciousness of

the teacher.

Stenhouse (1975), suggested that most classroom -based research tends to be conducted by researchers interested in producing research to support and validate their own ideas:

"Most of the work done in this area has relied on observers who are research workers rather than teachers. And, generally speaking, these workers have been more interested in building a theory of teaching and reporting observations in a form addressed mainly to the research community, than in improving the classrooms they have studied. This is not true of all the work reported, but there are almost always traces of the separation of the research worker from the teacher."

The research of four Hamble schools was designed and conducted by the researcher in order to illuminate the sense teachers made of the applications of microcomputers in their classrooms, with the belief that such material would be useful for the teachers concerned and for other teachers looking for advice or help.

Teachers reported back the activities of the previous week to the researcher during each of his visits. The visits occurred on average twice every three weeks, for five terms, for periods ranging from thirty minutes to a half day (in exceptional circumstances). Such an approach involving considerable teacher participation is not new in educational research. Other studies have been conducted involving similar methodological considerations to this research, with the main objective of illuminating the complexities teachers have to deal with in the classroom.

See, for example, Hull, et al (1985), Rudduck (1982). The work of Hull involved teachers being researchers in their own classrooms. The teachers underwent concentrated training in educational research methodology which enabled them to conduct valuable enquiries under the guidance of the research team. Such research can be seen to be useful to the teacher by providing an insight into the problems being researched, which could ultimately affect teaching strategies. The whole point to researching the introduction of microcomputers into primary schools was to undertake an investigation based within a framework of pupil-teacher-researcher collaboration.

Action Research.

The research did not take place exclusively in schools. Teachers were to also take part in in-service training, developed by the researcher as discussed below.

The majority of teachers (25/33) taking part in the research attended at least one course run at Hamble Technical College, (in the first instance, an introductory course). The courses were developed by the researcher and aimed at exposing teachers to a broad range of software available for use with primary school children.

The courses added an interesting perspective to the research taking place in the four schools. They enabled the researcher to develop a relationship with teachers from these schools which was outside the classroom but still within a structured environment. Much data was collected on these courses. Initially, the researcher had

intended to offer such courses for one term, to teachers in the local area. However, the demand was to remain consistent throughout the five term research period, so he continued to offer them.

As a result of this involvement in in-service training, the researcher had tentatively developed the framework within which his research was taking place. It was now based within Action Research. Halsey (1972), defined action research as follows:

"Action research is small-scale intervention in the functioning of the real world and a close examination of the effects of such intervention"

The researcher suggests that his research falls within this definition for the following reasons:

1. It was not envisaged at the beginning that all the schools were to rely so heavily on the researcher's in-service program, particularly during the first year. The county in-service programme was selective, (the nature of this selection is discussed later), and involved only one teacher (of those taking part in the research). Therefore, it could be argued that the college programme represented a small scale intervention, as discussed by Halsey above, since without it, in-service provision would probably not have occurred for these schools.
2. Cohen and Manion (1980), identified four tangible features of action research which again have relevance to this project, namely:

Situational features. They argued that a problem is highlighted and an attempt at a solution is effected. The initial problem, as seen by the researcher, was the lack of in-service training from official county sources at the time of the arrival of the computers. A local programme was set up since the location of an in-service programme was deemed to be vital, as discussed by Russell (1983).

Collaborative features, where researcher and practitioners work together on a project. Teachers were to provide much data for the project and formed part of the validation 'team' towards the end of the period.

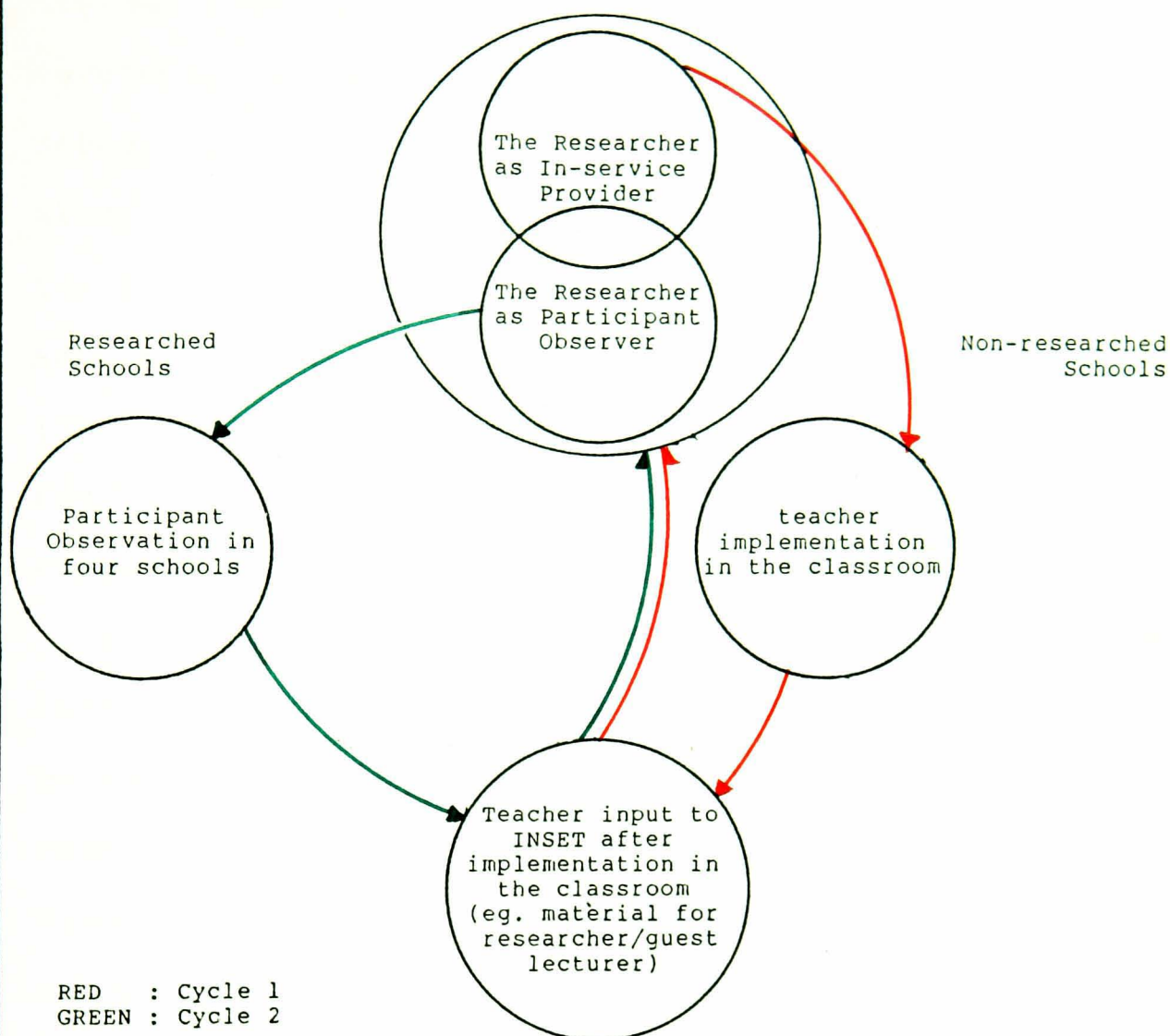
Participatory features. The researcher played an active part in the implementation period through his dual role as a participant observer/in-service course provider.

Self-evaluating features. Modifications occur throughout and are evaluated. The in-service programme changed as the researcher gained more knowledge of the applications of microcomputers in the classroom. As his knowledge increased, then this was fed back into the course.

The above realisations served to place the effects of the researcher, particularly through the in-service programme, within a methodological framework. He has placed research in schools and the ongoing work at Hamble College within the cyclic framework illustrated in figure 2.

Figure 2

The cyclic in-service/participant observation model.



The researcher was providing an in-service programme for both the researched schools and other local schools. Teachers attending the courses were to 'feed back' information into the courses through either the green path, or the red path.

Ethnography.

The researcher knew that there were to be many problems associated with a case-study approach, primarily through his own lack of experience. Considerable time was spent developing a sound methodological approach to the research, together with the relevant conceptual framework. Also, a case-study approach, although gaining acceptance, is still considered in some cases to be 'soft' research. Sage and Smith (1983), suggested that multi-disciplinary (including case study) research should be taking place in the broad area of computers in education, and that such research is urgently needed.

Much research has been initiated since the government incentive to supply finance for schools, but has tended to be centred around software, as discussed previously. The researcher envisaged that a case-study research project, based on a small number of schools, would provide useful, in depth information regarding the implementation of microcomputers in schools from the time of this introduction, and possible implications across the curriculum.

Data collection undertaken by the researcher occurred within an ethnographic framework. The researcher has adopted the term 'Ethnography' within the same framework as defined by Hammersley and Atkinson (1983), who suggested that ethnography is:

"..one social research method, albeit a somewhat unusual one, drawing as it does on a wide range of sources of information. The ethnographer participates , overtly or covertly, in people's everyday lives, for an extended period of time, watching what happens, listening to what is said, asking questions; in fact collecting whatever data are available to throw light on the issues with which he or she is concerned."

Many factors were to appear throughout the period which were outside the control of the researcher, and were to ultimately affect the scope of the project. One such factor was the arrival of the computer in one of the schools twelve months late! This was a major reason for the choice of ethnographic techniques. Ethnography provided the flexibility to allow for such uncontrollable factors.

The role of the researcher.

The researcher's role within the classroom was to act as a participant observer (a term cognate with ethnographer, Hammersley and Atkinson, (1983)). Often, a teacher would enlist the help of the researcher when something went wrong with both the software or the hardware. Also, the researcher was often called upon to provide his help and expertise in handling the hardware. Initially, the researcher believed that his function within the classroom was being misinterpreted by teachers on such occasions. This was not to be the case. The initial apprehension of the researcher soon disappeared when he adopted a 'floating' position- he would help in any way individual teachers wanted him to. He was not only

a participant observer but also an in-service course provider. This dual role necessitated him keeping an open mind when in the classroom. (Lacey (1970), was faced with a similar situation in that his research of Hightown Grammar involved him as a teacher and observer). As an example of the diverse nature of the researcher's role, the staff at Keeble (the largest school taking part in the research), expected the researcher to observe, and occasionally to rectify technical problems. In contrast to this, a teacher at Middleton (the second largest school) asked the researcher to introduce two classes to computer programming during another teacher's secondment. The research role was 'floating', as mentioned above, and changed to suit the needs of each particular school. It was also often the case that the researcher was called upon in his advisory capacity which had developed through the in-service programme.

The researcher's role was therefore tailored to meet the needs of individual schools. The three strands discussed above (i.e observer/ consultant/ teacher) were fundamental to the nature of the research and hence no attempt was made to eliminate the effects of the researcher on the data. He was totally involved in the schools during the period of the research. Such an involvement strengthened the reflexive nature of the research. Hammersley (1983) suggested that any attempt to separate the researcher from the researched is futile since the researcher is part of that social world. The

researcher was heavily committed to the initial implementation period through his dual role. As the research developed, the advisory part of the researcher's role grew, and tended to be centred around the application of various pieces of software in schools. Having used much of the software supplied with the computer, teachers wanted to progress to other available material. This often involved attendance at a Hamble College in-service course run by the researcher.

Teachers perceptions of the researcher varied according to his particular role at a moment in time. It was often the case that a class teacher under observation was also attending the college in-service course. Some teachers appeared nervous on occasions and seemed to expect the researcher to pass judgement on their classroom activities. Situations like this served to highlight the situation teachers were faced with. Each school had received a computer, and many teachers were not confident in its use. Many teachers looked to the researcher for advice. Also, many were to comment that the researcher was the only source of advice available throughout the research period.

Such apprehension and pressure on teachers did not mean that the researcher had unfriendly relations with teachers. On occasions when class teachers sought guidance, it was given. The researcher continued to gain experience from teachers attending his in-service course, and it was this experience that was passed on to teachers

taking part in the research. In some cases, teachers were to meet in order to discuss computer-related problems.

Crucial to the research was a friendly atmosphere between researcher and researched. By helping teachers where possible, the researcher created such an atmosphere. He actively encouraged teachers to exploit his computing skills. Often, equipment would break down, software needed to be transferred from cassette to floppy disc, connecting leads needed to be replaced, indeed computers were borrowed from Hamble College. It was always important that schools were benefitting from the researcher's presence, and this enabled an amount of 'trading' to occur- the researcher's technical skills and expertise 'traded' for the teacher's time and co-operation during observation sessions. This trading also served to demonstrate that the researcher was not an 'Exploitive Interloper', Hammersley and Atkinson (1983). The researcher was part of a reflexive arrangement- he was giving help and advice to teachers- teachers were giving him data through access to their work. In a sense, both parties (the researcher and the teachers taking part in the research) were exploiting each other.

The most common enquiry from teachers was to find out what to do when something went wrong with the computer. The availability of the researcher was to be invaluable to the research schools, since such problems could usually be dealt with very quickly, involving either maintenance during an observation session or a telephone call to the

college with a request for assistance. The most demanding time involving this type of assistance was during the arrival of disc drives at the beginning of the second year. Software had to be transferred from cassette to disc. Often, teachers were unable to do this because they did not know the processes involved.

The researcher's attempt at developing good working relationships with staff was necessary and indeed central to the development of the research. Without such relationships, it would have been difficult for the researcher to be an effective ethnographer.

Data Validation.

the researcher's interpretation of the data needed to be reliable and able to stand up to close scrutiny, especially the scrutiny of the subjects of the project. The schools were visited as often as possible, depending on the time available to the researcher, as mentioned on page 36. All four headteachers were quite flexible regarding times of visits by the researcher, and allowed visits on a 'take me as you find me' basis.

Where various teachers were to use the computer equipment throughout one week, as opposed to allocation on a weekly basis, the researcher would visit the school at different times so as to gather a clear picture of events taking place in the school. Also, the presence of the researcher on site did not necessarily involve observing teachers using computers with children. It was important to the researcher that individual teacher interpretations

of the sense they were making of the use of computers in school was recounted to the researcher. He was to make time available for staff to discuss their findings of the previous week with him. It was never adequate for the researcher to interpret a piece of data as a result of an observation session and present the findings to the school. Each school was involved in negotiating the results with the researcher throughout the 'writing up' period. Such evidence was duplicated by the researcher and given to the headteacher for comments and discussion with him and was made available to the teaching staff for comments. Also, each school was to receive at least one interim report from the researcher during the research. This report was made available to all staff for consideration, and amendments made where necessary.

When the researcher undertook the task of analysing his collected data, he illuminated key decisions which all schools had to make. He decided to focus on these key decisions (as illustrated in the flowchart on page 59), in the production of the case-study section of the research. He preferred this to producing a chronological account of school activities as it provided a framework within which to contrast the schools.

Triangulation

Data collection occurred from three sources:

- (a) The researcher's observations.
- (b) Interviews and discussions with teachers with particular reference to their intentions and perceptions

of their work with the children and the computer. Also, most teachers were to produce written guidelines and observations to aid the building up of a complete picture of microcomputer usage and applications.

(c) Interviews and discussions with pupils, both individually and in the presence of the teacher, again with particular reference to pupil perceptions of the interactions between the pupil, teacher and computer.

Generally, this method of data collection falls within a framework of Triangulation. Denzin (1970), discussed the major types of triangulation used in social research. The category which best describes this particular enquiry is investigator triangulation, where the researcher is a part of the triangle formed from teachers and pupils playing an active part in the supply of source data.

Walker and Macdonald (1976) described the procedures adopted by the researcher as follows:

" The process of gathering accounts from three distinct standpoints has an epistemological justification. Each point of the triangle stands in a unique epistemological position with respect to access to relevant data about a teaching situation. The teacher is in the best position to gain access through introspection to his own intentions and aims in the situation. The students are in the best position to explain how the teacher's actions influence the way they respond to the situation. The participant-observer is in the best position to collect data about the observable features of the interaction between teachers and pupils. By comparing his own account with accounts from the other two standpoints, a person at one point of the triangle has an opportunity to test and perhaps revise it on the basis of more sufficient data"

Much data was collected from school staff in various settings, namely the classroom, the staffroom, and the college course. It was useful to talk to staff over coffee during both playtimes and lunchtimes as chance remarks which would not be communicated in the traditional research setting, i.e the classroom, would often be spoken in a more relaxed atmosphere. This type of data collection can often create an ethical problem for ethnographers. How much data should be recorded in such circumstances?. It was sometimes clear that on such informal occasions, only the researcher was aware that chance remarks were being recorded. Such recording was necessary, providing the evidence was made available to the staff concerned. These ethical problems, together with the validity problems referred to earlier, were dealt with pragmatically through the negotiable nature of the outcomes of the project.

Childrens' perceptions of the researcher were varied. One reason for this was the diverse role played by the researcher in the four schools. At Middleton, the researcher was asked to introduce some children to programming in the early stages, which necessitated adopting a teacher role. A similar situation occurred at Sunhill, where some children were introduced to information retrieval. No such directive role was adopted at Keeble or Monkham, although help and advice was obviously given by the researcher when requested. However, it was inevitable that most children were to perceive such a researcher as the 'computer expert'. On one occasion, he

was introduced to a class as this.

Data collection from class members was also varied. It was soon realised by the researcher that children were communicating more easily with the researcher when the teacher was not present. It was not a deliberate move on the researcher's part to isolate pupils from their teacher, but was necessitated in some cases by the siting of the computer equipment outside the classroom. This was to mean that observation sessions and researcher- pupil interaction occurred without the teacher present for the majority of the time. In cases where the computer was sited within the classroom or class area, teachers were usually quite happy to leave the researcher alone with the computer users, communicating with the researcher afterwards to find out what had been said. This feedback from researcher to teacher was to become another tool which ultimately strengthened the relationship between the researcher and the researched.

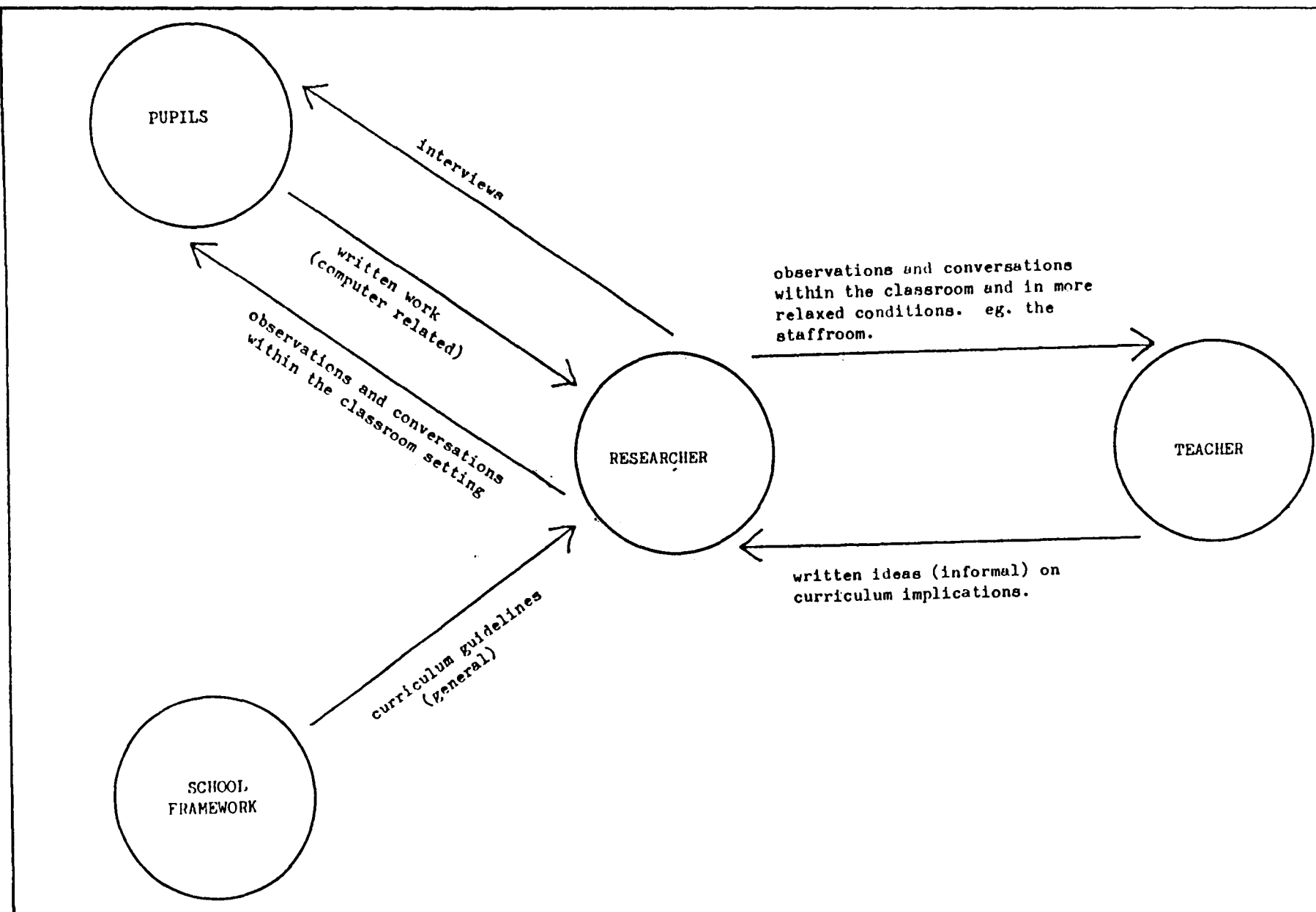
Towards the end of the research period, the researcher interviewed various pupils from the schools. The reason for this was straightforward: Certain key issues had emerged during the course of the study, and it was decided to ask pupils questions about these key issues. The interviews served to check-out the researcher's own observations and discussions with both teachers and pupils throughout the period, in various settings.

Summary

The research methodology was complicated. The researcher was both an ethnographer and an in-service provider which involved him adopting different roles depending upon the circumstance. These roles facilitated data collection for the purposes of research. As the research progressed, he developed an action research framework within which to justify the complexities of the methodology. Overall, these complexities were necessary in order to illuminate the problems associated with the introduction of this innovation. Triangulation, the data collection perspective, is illustrated overleaf in figure 3.

Figure 3

The triangulation model.



Chapter 4

The theoretical background.

The mass introduction of computers into primary schools took place over an approximate two year period. For the purposes of this research, such an initiative has been seen by the researcher as an innovation. By adopting such a view, it was possible to apply a model for the processes of supplying hardware to schools and also the maintenance and development of both hardware and software systems. An adaptation of the Schon Centre-Periphery model, Schon (1971), was chosen to act as a tool for evaluation. Schon described the model as follows:

"This model rests on three basic elements: The innovation to be diffused exists, fully realized in its essentials, prior to its diffusion. Diffusion is the movement of an innovation from a center out to its ultimate users. Directed diffusion is a centrally managed process of dissemination, training, and provision of resources and incentives. Advocates of center-periphery theory have tended to see diffusion as 'the human interaction in which one person communicates a new idea to another person. Thus, at its most elemental level of conceptualization, the diffusion process consists of (1) a new idea, (2) individual A who knows about the innovation, and (3) individual B who does not know about the innovation."

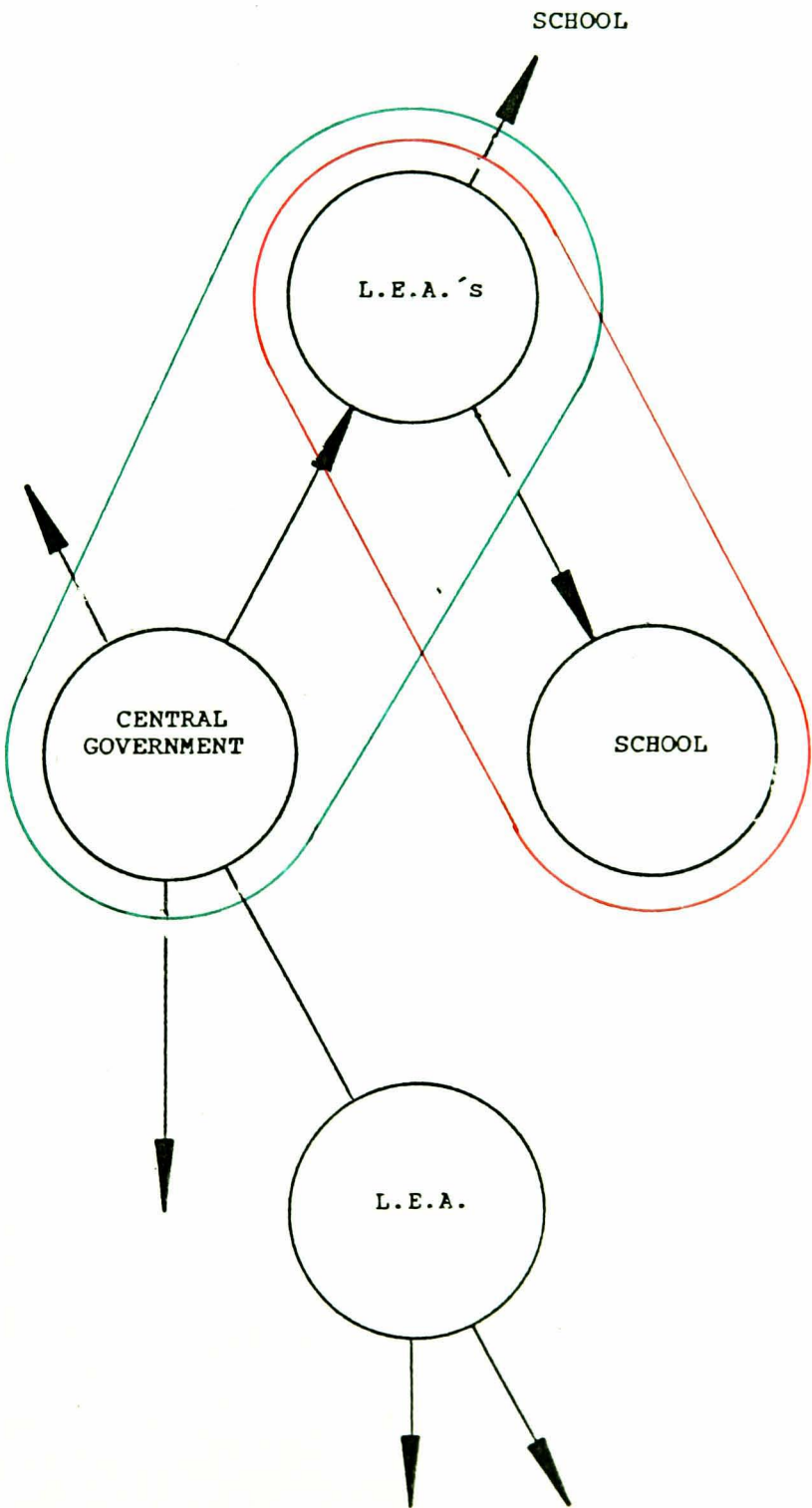
There were many agencies involved in the ultimate implementation of microcomputers in primary schools. With these agencies in mind, the researcher formulated a model of diffusion, which is, in fact, a development of the Schon model. It involves Primary and Secondary centres with the following functions:

- 1. Primary centres. These have a supporting and management function.
- 2. Secondary centres. Their function is to diffuse the innovation.

Figure 4 illustrates the nature of these primary and secondary centres for the purposes of this research:

Figure 4.

The researcher's adaptation of the schon model



There is considerable overlap between these two types of centre. Often, one becomes the other. For example, the L.E.A. centre is secondary with regard to central government, because it is managed by central government, as illustrated through the green ellipse. However, the L.E.A. is a primary centre with regard to the distribution of microcomputers to schools, as illustrated by the red ellipse, since schools are managed by L.E.A.'s.

The researcher soon realised that the model could be equally applied to other aspects of the research. Figures 5-7, illustrate the provision of finance, training, hardware:

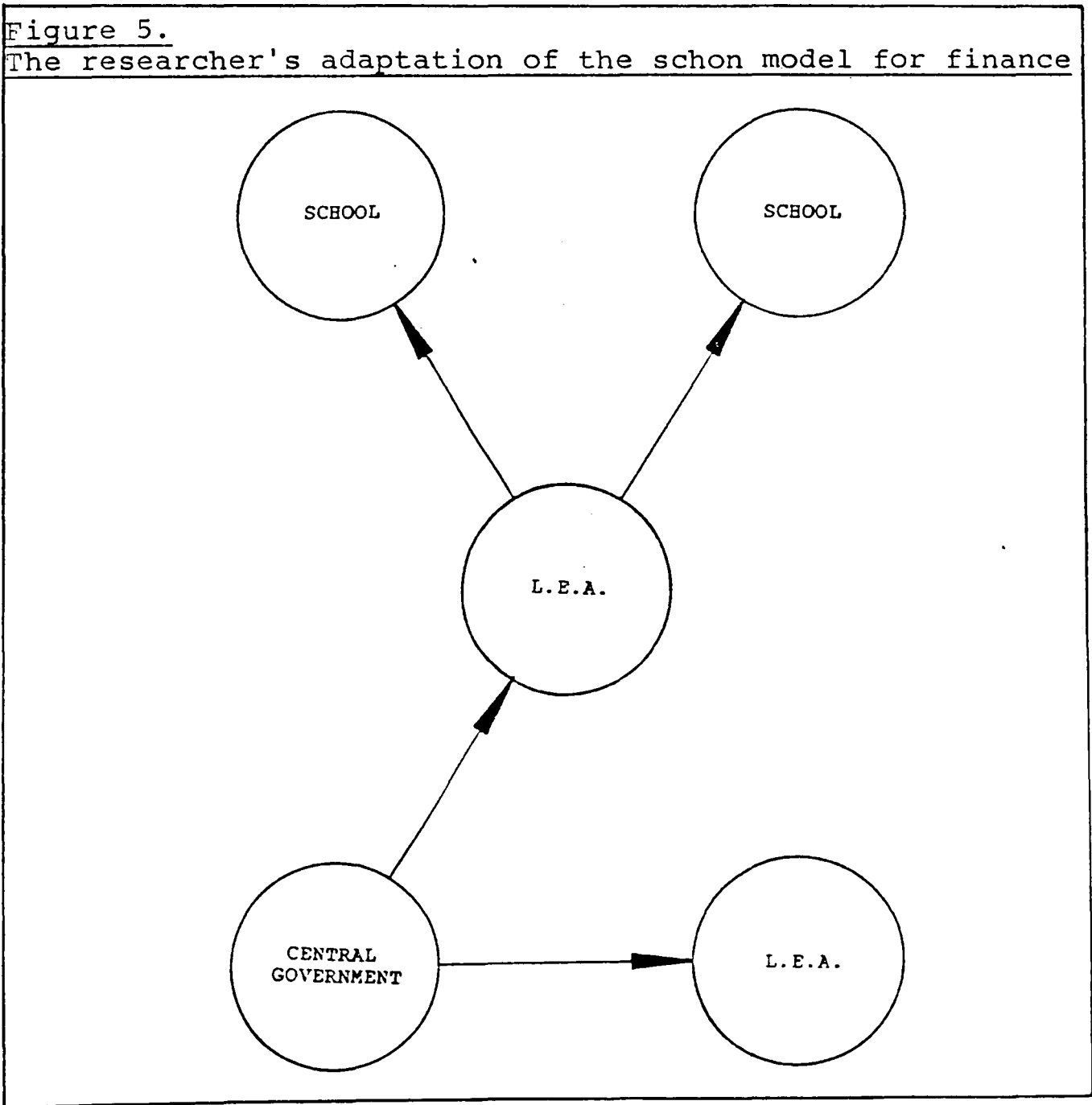


Figure 6.
The researcher's adaptation of the schon model for training

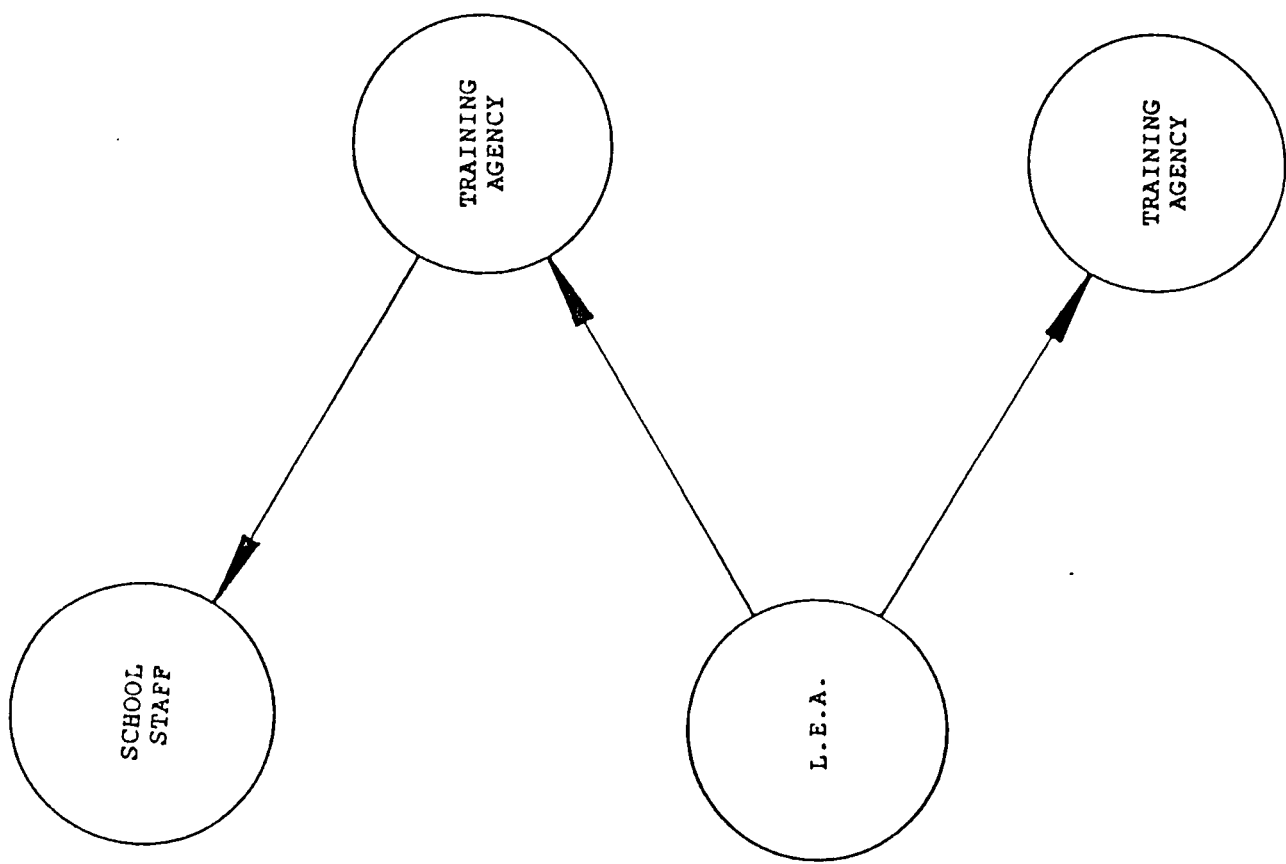
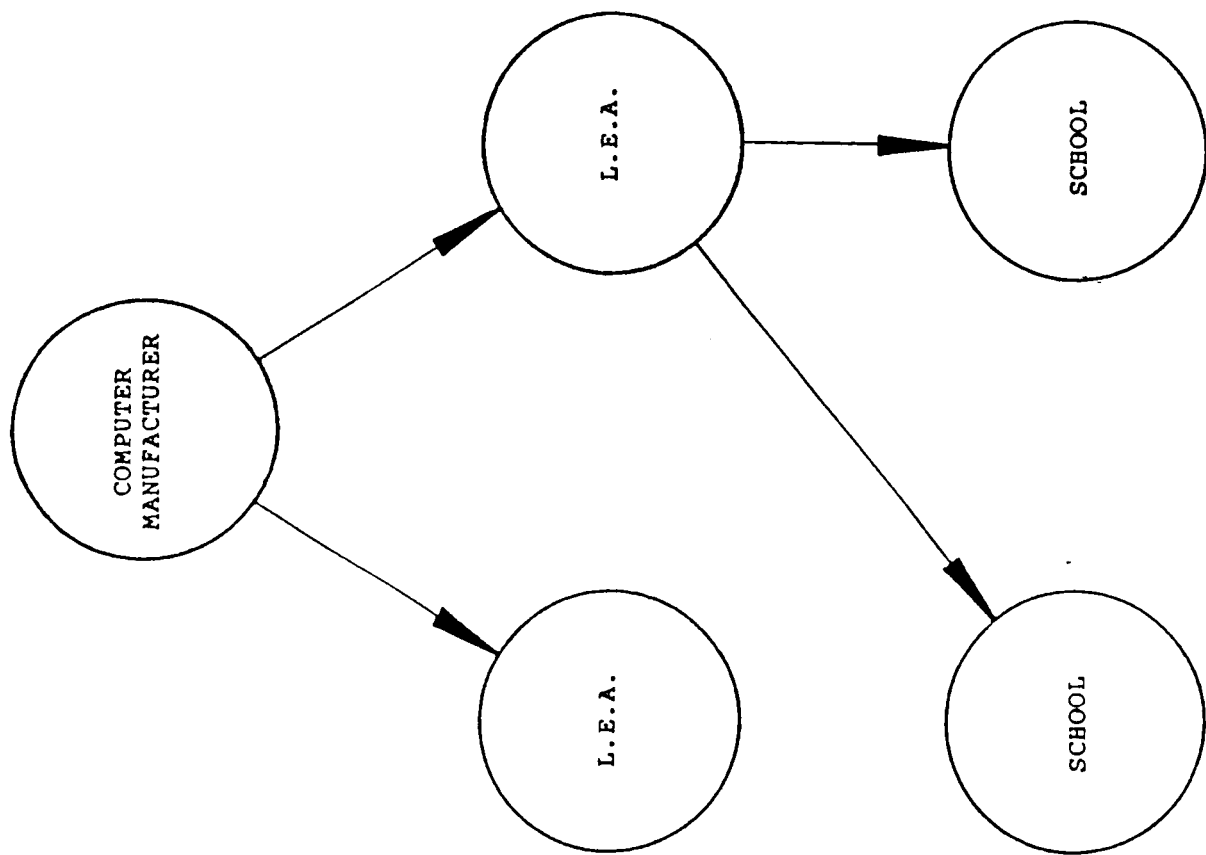


Figure 7.
The researcher's adaptation of the schon model for hardware



Schon suggested that the overall effectiveness of this model relies on several factors:

"The effectiveness of a center-periphery system depends first upon the level of resources and energy at the center, then upon the number of points at the periphery, the length of the radii or spokes through which diffusion takes place, and the energy required to gain a new adoption."

Summary

The Schon model provided the researcher with a framework to investigate the introduction of computer hardware into schools. It was an economic model, adapted within an educational context. It was a particularly pertinent model to adopt because the introduction of computers into primary schools relied on LEAs and headteachers taking a basic economic decision: - do we buy a computer? The four schools taking part in this research decided to buy a computer system and then became involved in the finance, training, and hardware distribution associated with such a decision.

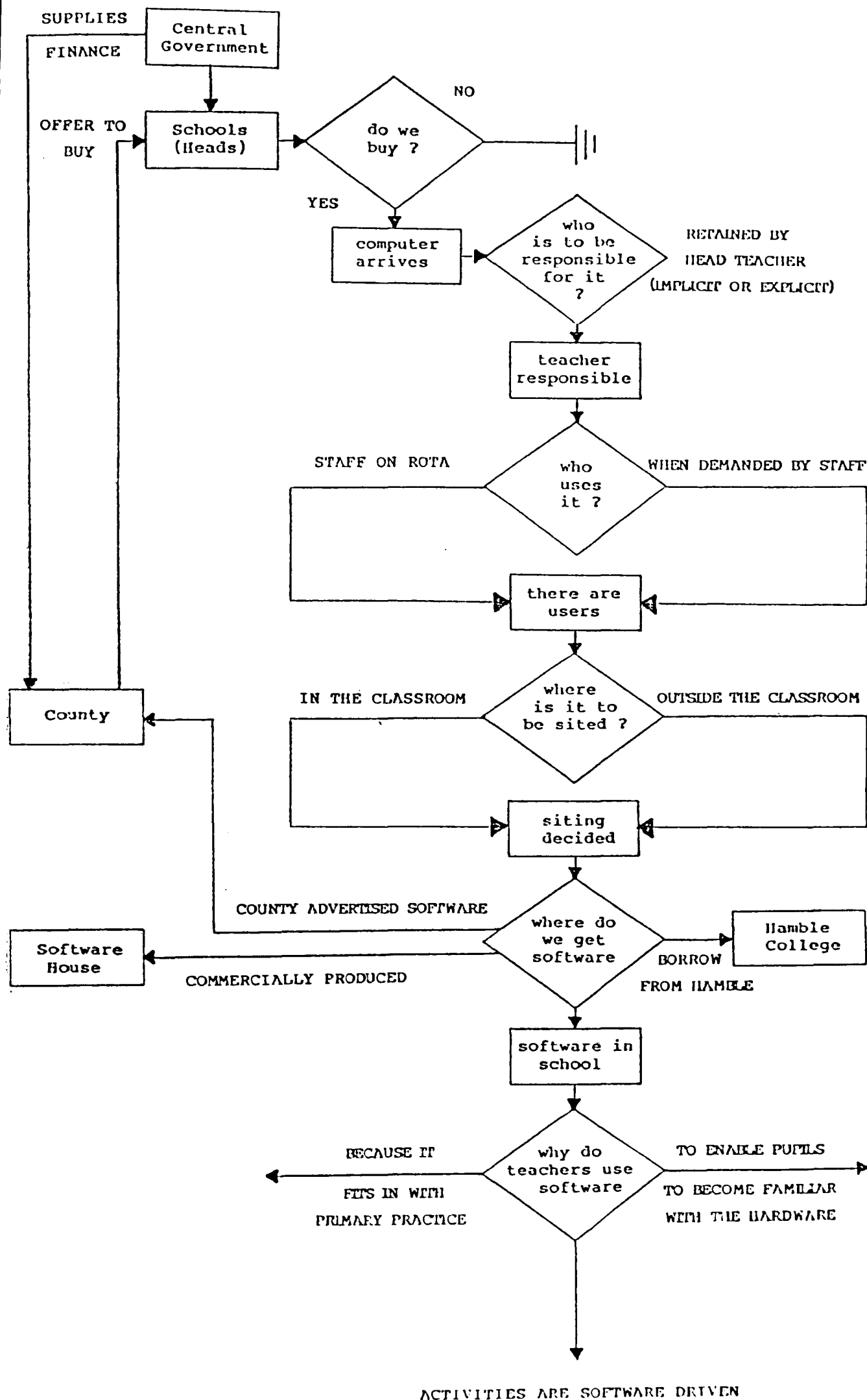
Once the computer system was installed in the classroom, teachers then had the responsibility to use it with children. Teachers saw the computer for what it could do, through software. The researcher has discussed the sense they made of the computer in the following two chapters.

Chapter 5

Case Study

This chapter is intended to focus on the organisational and management aspects of the introduction of microcomputers into the four primary schools. It was decided that after data analysis, the development of such organisational and management aspects could best be affected by contrasting the decisions faced by the schools throughout the period. These decisions were common to all four schools. This provided both a framework within which the researcher could document the data collected through observation sessions, and any differences in the decisions made by the schools. The decisions schools had to make were progressive and are illustrated in the flowchart (figure 8), devised by the author:

Figure 8
Flowchart of key decisions made by schools.



The decisions to be made were as follows:

1. Who made the decision to buy the computer?
2. Who was given responsibility for the equipment?
3. Who was to use the computer?
4. Where was the computer sited?
5. Where did teachers obtain software?
6. Why was a piece of specific software used?

Details of individual school responses to these decisions were as follows:

Who made the decision to buy the computer?

As documented elsewhere, the 'hard to refuse' offer, Smith (1984), was paramount in the decision taken by the four headteachers to buy a computer system. All four headteachers made the decision to buy after consultation with staff. In the case of Keeble, this occurred after consultation with senior staff. All four headteachers freely admitted their ignorance of possible applications within their schools, and were grateful for any external help/ advice/ research which was available. Table 3 illustrates the hardware resourcing and class sizes of the schools.

Table 3.
Hardware resourcing in the four schools.

	<u>Number of computer systems</u>	
	<u>Year 1</u>	<u>Year 2</u>
1. Sunhill C.of E. County Primary School	1	1+ disc drive
2. Middleton County Primary School.	1	1+ disc drive
3. Keeble County Primary School.	0	1
4. Monkham County Primary School.	1+ disc drive + printer	2 both with disc drive + printer

Notes.

A computer system refers to:

1. A computer.
2. A monitor (screen).
3. A cassette recorder for loading programs

disc drives were not supplied under the 'Micros in Schools' scheme.

Schools 1-2 bought their disc drives during year 2 under a subsidised scheme from county.

Keeble did not receive their computer system until the end of the first year.

Who was given responsibility for the computer equipment?

Three of the four schools had a member of staff implicitly responsible for the computer and its related equipment. All three had scale posts, one being deputy head. All had responsibility for mathematics. These responsibilities are illustrated in table 4:

Table 4
Computer responsibility.

<u>School</u>	<u>Teacher</u>	<u>Responsibility</u>
Middleton	Mrs Harris	Scale 3 Mathematics Implicit computer responsibility
Monkham	Mr Thomas	Deputy head Mathematics Implicit computer responsibility
Keeble	Mrs Wagstaff	Scale 2 Mathematics Implicit computer responsibility
Sunhill	No member of staff had responsibility	

During the first year of the research, Keeble did not receive their computer and consequently there was no participant observation sessions undertaken by the researcher. However, various members of staff attended the college in-service programme. The implication from this is that the Keeble staff were more involved in in-service work before the acquisition of the computer than any of the other schools. In the case of Middleton and Monkham, the teachers responsible for the equipment were to be the first from their schools to attend a college course, and the first to introduce the computer into the school. At Keeble, the teacher responsible for the computer was involved in the introduction of the computer into the school, along with three other members of staff. Sunhill provided an interesting contrast to Keeble throughout the research, because the schools are so different in size. No teacher was to have responsibility for the computer at

Sunhill, although the headmaster introduced it into the school. At the time, his two staff expressed little interest in it.

Towards the end of the research, the researcher met with the County Inspector for Primary Education and raised the matter of the possibility of post holders for computing. The Inspector said that he did not see computers demanding scale posts, since they are not a curriculum area in their own right. He viewed them as supporting the curriculum.

Who was to use the computer?

This particular question was answered by the staff concerned in different ways. The use of the computer throughout the school was investigated by the researcher with regard for the Schon model.

Table 5 illustrates the 'take up' of the computer within the three schools taking part in the research for five terms. For example, 2/8 refers to two teachers (out of eight) using the computer at the beginning of a specified term. The fourth school, Keeble, is not included in the table because the research period was for two terms, one of which was a staff evaluation term and hence few staff used the computer.

Table 5					
When teachers began using the computer					
	Aut1983	Spr1984	Sum1984	Aut1985	Spr1985
Middleton	2/8	3/8	5/8		
Monkham	2/6	5/6	5/6	6/6	
Sunhill	1/3	3/3			

As individual teachers are discussed, the classes they

taught are mentioned in brackets after their name. If they changed age groups for the second year, the two years are separated with the / symbol. All classes are junior unless otherwise stated.

At Middleton, the innovation was disseminated throughout the junior classes. By the end of year 1, all five junior classes had used the equipment.

Mr Walker (3rd) and Mrs Harris (4th) were the first users of the computer. Mr Walker took the opportunity during Mrs Harris's secondment to invite the researcher into the school to introduce Mr Dent's class to the computer. Mr Walker was implicitly responsible for the computer during Mrs Harris's secondment. Mr Dent (3rd,4th year class) was about to take early retirement and was not interested in taking on new work. This was an opportunity for the researcher to strengthen relations with the school by providing an input, as directed by Mr Walker. From Easter, 1984, Mrs Jones (2nd) and Mrs Leaf (1st) began using the computer. This constituted the construction of the first timetable for the use of the computer. Mrs Leaf was allocated Thursday afternoon, and Mrs Jones Tuesday afternoon. The rest of the time was divided between the other three junior classes.

The second year of the research was to see a more evenly distributed usage throughout the junior classes. Mrs Jones's time was increased, and there were slots during the week which were empty. These were invariably taken up by individual teacher demand.

Infant classes did not use the equipment throughout the research. One reason given by Mrs Harris was the lack of resources. Ideally, she would have liked two computers, or even more.

At Monkham, the use of the computer throughout the school occurred in a similar way to that at Middleton. One teacher introduced the computer into his classroom, then gradually, other members of staff became involved.

During the autumn term, 1983, Most usage in Mr Simpson's class (3rd,4th/1st) was directed by Mr Thomas (3rd,4th/3rd). This was quite convenient because the computer was sited between their two class areas. Mrs Franks (inf,1st year jun) left the school at the end of the first year. There was a slight reorganisation of classes at the beginning of the second year as Mrs Franks was not being replaced. This involved Mr Minter teaching half time, and a part time teacher taking the class the other half. Mr Minter (middle,top inf) began using the computer immediately, and encouraged the other half time teacher, Mrs Ho, to do so.

Towards the end of the first year, Mrs Burt (2nd/4th) mentioned to other staff the possibility of timetabling the computer, but was met with opposition, particularly from Mr Thomas. He felt that it was best used when it was needed, rather than a class being timetabled for a specific 'computer time'.

At the end of the first year of the research, the headmaster bought a disc drive, printer, and second

computer system. Immediately, children were to have more 'hands on' time. The new machine was to reside in the infant area, (two classes), while the original computer remained in the junior classes. Organizationally, this was to mean that there was one computer between two classes, (Infant), and the other between three, (Junior). The infant classes were to share use, whereas Mr Thomas had more use of the junior classes' computer than the other two junior teachers. His enthusiasm for using the computer in the classroom was consistently high from the beginning of the research.

At Sunhill, the use of the computer throughout the school was to take place in a similar way to the two schools already discussed. The headteacher, Mr Hart (3rd,4th/2nd,3rd,4th) introduced the computer to his class. After one term, the other two teachers began using it, although Mr Winter (1st,2nd/inf,1st) was always apprehensive about its use because he felt that the software available to him was inadequate.

Mr Winter's use in the classroom was rather inconsistent in that he did not always make use of it when it was allocated to him. This allocation process took the form of a timetable, drawn up by all three staff.

Also, Mr Winter was seconded during the summer term of the first year (1984), and was replaced with a temporary teacher. This teacher had not used computers before and tended to allow children the freedom to explore with various computer programs. Consequently, the dominant

children within the class were the main users.

At the beginning of the second year of the research, Miss Jennings (all inf/rec, 2nd inf) expressed a need for more computer time. Consequently, a revised timetable was drafted by the staff. Allocation of the computer was now cyclic, on a weekly basis for each class. However, Mr Winter had a small class, and it was considered unfair by the headteacher to allocate him a complete week. Also, the part-time teacher of Mr Hart's class, Mrs Walle, was expressing an interest in using the computer. As a result of both of these factors, Mr Winter had the machine for the first three days of his week, the other two days were taken up by Mrs Walle.

The peripetetic remedial teacher attending Sunhill also used the computer on occasions, usually with small groups of children. This was not included in any timetable as each use occurred only if the current teacher with the computer was not using it.

At Keeble, the main problem faced by the researcher was the fact that the school did not receive their computer until the beginning of the second year of the research, (Summer, 1984). This was to mean that year two of the research was not to take place at Keeble. However, a structure did emerge regarding the allocation of the computer to individual classes.

At the beginning of the year before the arrival of the computer, the headmaster issued a memo to all staff which tabled a proposal for the introduction of the computer

into the school. He suggested that:

1. Two week "hands on" familiarisation for staff;- possibly a workshop.
2. Two/three weeks for "hands on" for children in all classes.
3. One teacher from each of the three bands to have blocked time each week (simultaneously) over a period of one half of a term.
4. The three pioneer teachers to identify software required for January/February start.
5. Full staff to examine the implication of the pioneer work done at the conclusion of the first phase.
6. During first phase, three more teachers to be required (volunteers) for the second phase (next half term).

However, nearly one year was to pass before the computer arrived, and alterations to the proposal were made, after consultation with staff. The autumn term of 1984, (the second year of research for three schools, the first for Keeble), was to be their trial period. The initial plans as illustrated above were not implemented. Instead, four classes representative of the different age bands were to each have the computer for two periods of one week, on a rota basis during an eight week period. The headmaster made it clear to the researcher that the main objective of the introduction of the computer into the school was to give every child some "hands on" experience of it, no matter how little time was available. To this end, allocation of the computer after the trial period was to

be on a weekly basis for each class. By the end of the first term with the computer, twelve classes had used it for one week each. Another class introduced it during the second term. Overall, staff usage throughout the two and one half terms is illustrated in table 6.

<u>Table 6</u>	
<u>Staff useage of the computer at Keeble</u>	
<u>No. of weeks of use.</u>	<u>No. of teachers.</u>
0	1
1	8
2	4
3	1

The table includes the trial period. Also, Mrs Bishoff was temporary,(autumn), and is consequently not included.

The organisational precision discussed above was in sharp contrast^{to} computer usage at Sunhill, where each class had much more 'hands on' time due to the smallness of the school. Mr Jepps, (headmaster, Keeble), stated that continuity of computer usage by pupils was being sacrificed by enabling each class one week, in turn, of computer usage.

Where was the computer to be sited?

At Sunhill, the computer was sited in the library area. This was next to Mr. Harts' classroom. Subsequent usage included children having to leave the classroom and enter the library. This created immediate problems - it was not always possible for Mr. Hart to monitor computer activity. Initially, he would load up a program which groups of up to three children would work with. Observation sessions undertaken by the researcher were conducted in the

library, and it was often the case that he would assume the role of adviser to children, necessitated by the unavailability of the teacher.

Towards the end of the second year, Mr. Hart moved the computer into his classroom. This coincided with the use of DART. He had used the program before, but now had definite ideas about its application. He said "I know what I want with Dart". This confidence seemed to be related to the movement of the hardware into the classroom, a matter which was later substantiated by Mr. Hart.

Both Miss Jennings and Mr. Winter sited the computer within the classroom, in the same location for each week of use. At the end of the school day, the computer was locked in the stock cupboard for security purposes.

The siting of the computer at Middleton was to be different from that at the other schools, in that it was housed in a computer room throughout the research period. Use of the computer involved displacement from the usual classroom situation for all classes. This location was to be next to Mrs. Harris's area.

During the introductory period, usage by Mr. Walker involved children travelling to the computer from his mobile. This was to be the case for all subsequent usage by other teachers. In the case of Mrs Jones and Mrs. Leaf, occasional help was enlisted from parents to monitor the situation within the computer room when their classes were using the computer. Mrs Harris's and Mrs Jones's location was more convenient than that of other members of staff,

in that they were situated next to the computer room, which involved little travelling by children. Also it was to mean that the two teachers concerned were able to monitor progress within the computer room more closely. After school, there was no need to lock the computer away as the room used during the day was able to be locked.

The siting of the computer at Monkham was in the individual class areas or an adjacent area. Unlike Middleton, children did not have to travel far to use the computer and individual teachers were close at hand to rectify problems. The movement of the computer was not really a problem for staff during the first year since junior classes were the main users, and they were all situated close to each other. The second computer arrived at the beginning of the second year and was to be permanently sited in the infant area, which was to mean even fewer problems regarding movement. The original computer was to remain in the junior area. At night, both computers were locked in the stock cupboard.

Keeble School has a large open plan area which accomodates eight classes, seven of which used the computer during the year. Each of these classes had the computer in their area during their week of use. The other teachers were sited in mobile classrooms, and all had the computer in their mobile during their week of use. This created problems of security since it would have been dangerous to leave the system in the mobile classroom overnight, hence it had to be physically removed from the

mobile each afternoon. All teachers were to comment on this chore. This seemed to be another problem created by the size of the school. With fourteen teachers using the computer at some stage, considerable movement of the hardware was inevitable.

All four schools had computers mounted on a trolley. With the exception of Middleton, where the computer was sited in its own room permanently (lockable), teachers had to return the computer system to a stock cupboard at the end of every school day. This was often inconvenient to teachers. One disadvantage with the system in operation at Middleton was that although the computer did not have to be locked in a stock cupboard overnight, its location was permanent which was to mean that children had to walk to the computer room in order to use it. It was often the case that the teacher was unable to be with the child using the computer.

Where did schools obtain software?

The flowchart contained in figure 8 (page 59) suggests three primary sources of software for schools, namely:

1. Software borrowed or copied (where copyright did not apply), from Hamble College.
2. Software developed or sponsored by county.
3. Software purchased from commercial software houses.

In addition to these primary sources, two secondary sources were to emerge:

1. Software brought into the school by staff.
2. (To a lesser extent), software brought into the school

by pupils.

Table 7 reflects the source of the software used by each school, and percentage of material from that source:

Table 7				
Source and amount of software used by Schools				
Source	Percentage/number of programs (n)			
	Middleton (n=25)	Monkham (n=25)	Sunhill (n=19)	Keeble (n=25)
Microprimer	56	44	62	60
College	12	40	16	0
County	8	4	11	0
Teachers	16	4	11	20
Software	8	8	0	0
House				
Pupils	0	0	0	20

The MICROPRIMER software was to supply the majority of material used in each school. It provided a common starting point and enabled teachers, in many cases, to introduce the computer to the children. Most teachers used it because it was there, even though in many cases, they were to comment that if it was not there, they would probably not buy it. Keeble was the only school not to borrow software from college. There were two reasons for this:

1. The main objective of the introductory period of two months was to enable all children to use the equipment. Teachers were not particularly selective with software at this stage and were quite happy to use MICROPRIMER software.
2. Individual children throughout the school were never to be allocated much time on the computer because of the demands on the equipment. Each class would have the computer for a period of one week every thirteen, hence

little in depth work was accomplished. If the research in the school had started the previous year, teachers may have channelled the use of the computer into a more confined area, and requested relevant support software from the college. Such development began to take place after the research had finished.

Monkham staff were to attend substantially more in-service courses than the other schools, and this is reflected in 40% of software used having been secured from college. Much material was freely copyable and Monkham staff were to take full advantage of this. Also, they were to borrow software from the college

All four schools had one teacher who brought in software for use with children. The teachers concerned each had their own B.B.C computers at home, and were purchasing material themselves.

Very little software was purchased from software houses during the research period. Indeed, only two of the schools purchased any at all. The main reason for this was that teachers were experimenting with software, that is, using software with no clear aim in mind, simply developing approaches to using software with respect to the reactions of children when they use it. During the research period of five terms, teachers continually used the software which was freely available, as discussed earlier in this section. It was not until after the conclusion of the research that schools generally began purchasing software.

A pupil at Keeble was to bring software into the school for use within the class. There was no other occurrence of this.

Why was a specific piece of software used?

Teachers were to use individual pieces of software for various reasons. The theme which was to emerge from the schools, and particularly the three schools who were researched for five terms, was that as teachers became more familiar with the computing equipment and its capabilities in the classroom, then they also became more discriminating about the software they used. Although it is difficult for the researcher to include developments at Keeble within this theme, one member of staff has maintained this trend after the research period. Generally, the reason for choosing a particular piece of software came from the following list:

1. The software enabled the pupil to become familiar with the computer, and in particular, the keyboard.
2. A curriculum centred choice. The software was seen by the teacher to back up an existing classroom activity.
3. A program centred choice. The software was chosen by the teacher because it was seen as being worthwhile, even though it may not have been related to an existing classroom activity.

Individual teachers, with the exception of the staff at Keeble, produced notes for the researcher during the second year of the five term study regarding their use of the computer with children. This formed part of the

validation process of field data collected by the researcher, and equally importantly involved staff in the negotiation of the results. This was crucial as the research was focussed on teachers throughout.

Teachers responded to the selection of software in the following ways. Comments made were taken from teacher documents passed to the researcher:

At Middleton, Mrs Harris viewed the MICROPRIMER software as a means of introducing the computer to children. This attitude is reflected in the following:

"The first year was a matter of exploring the M.E.P. software- both with and without the children. But as I feel that all the children enjoy "a go" at the computer, and as they may react different, I tried to let every child have as many "goes" as possible. This, of course, limits the amount of work explored. I think that it would be ideal to have a computer available to each class, so that whatever is going on in the classroom can be reinforced or expanded by work done with the computer".

Most of the first year was spent using the MICROPRIMER software. The second year was quite different in that computer activity was geared around just two programs- DART and FLOWERS OF CRYSTAL. DART was used, and continues to be used, as an integrated piece of work in the classroom. Exercises involving DART were usually structured, rather than open-ended, and were designed to develop problem solving and geometric skills in children.

FLOWERS OF CRYSTAL is an adventure game. Mrs Harris used the program exclusively with her class for one term. The producers of the package intended it to be a generator

of peripheral work within the classroom. This is what happened to some extent, and so activities suggested by the program were generated as a result of using the program. Mrs Harris originally chose the program because she felt that the class needed to use software with more depth than the MICROPRIMER software. She was to comment that activities related to FLOWERS OF CRYSTAL occurred because of the timetabling restrictions on the computer:

" We have used the Dart program as an integrated part of work going on in the classroom, but more often it has been an "extra"-e.g. Flowers of Crystal, which, although we did follow up work in class time with oral work, creative writing, problem solving techniques, and art work, really originated from the fact that we were timetabled for certain sessions on the computer, and Flowers of Crystal lent itself to this kind of use."

Mr Walker spent the first year using the computer in a similar way to Mrs Harris, by familiarizing himself and the children with the computer and related software. This was mainly confined to simple programming and the use of the MICROPRIMER software. He had problems monitoring the use of software which were necessitated through the location of his classroom- he was sited in a mobile outside the main school building. During the first year, most programs were chosen by him in order to familiarize children with the computer, hence computer activities were program driven, although occasionally such choice of software would coincide with an existing classroom activity.

During the second year, he was more confident about

selecting software which he felt was suitable for use with his class. The following extracts contain information regarding two programs which he felt were suitable: An ENGLISH CIVIL WAR and GRANNY'S GARDEN.

"English Civil War at Middleton. Prog: Helmut Watson (Son). Aim: In connection with history lessons on this subject. Comments: 1a. The disc drive enabled us to do this. 1b. Done in my own class room. 2. Too many children present. 3. Boys dominated where they could. Conclusions: Worth doing."

The use of this program was linked to an existing classroom activity and is thus classified by the researcher as curriculum centred.

"Granny's Garden. How selected: Almost random grouping. Allow friends or table partners to go together with others chosen so as to present a group of reasonably mixed ability. There should be at least one good reader whenever possible in each group. I suggest this for maximum chance of comprehension. In a group with, say, no really good reader then two fair readers will puzzle out any problem but might take a little longer over finding the solution. (Supposition on my part). How long: Attempt to give up to one hour sessions so that each member of a group gets keyboard time. One hour, (or usually slightly less), is o.k for 3,4 or 5 pupils. I can only visit them once or twice during that hour.

Discussions took place between Mr Walker and his class after they had reached a certain stage in the program. All such activities were centred around the program.

Mr Walker was prolific in various notes and comments passed to the researcher. These notes invariably contained some essential points which he, and the researcher would discuss at length. The following extracts contain the essence of his points:

"The computer's introduction in school represents another item for consideration by the busy junior school teacher. It could be said to be a nuisance!."

Here, he has highlighted the compulsion to use the computer simply because it was there. Several teachers were to comment on this throughout the research. This does not imply force from within the school to use the computer, but simply yet another teaching aid for examination, for use within the classroom. He continued:

"During the first year of the B.B.C's introduction, only two teachers and three classes were involved. Timetabling was not too much of a problem. Now, (second year), four teachers and two helpers are using the computer and at least two classes and maybe a total of more than four groups. The timetabling has become almost essential. This is not so much as to give everyone a "fair share" but in order to fit in with each individual class timetable. Apart from timetabling restrictions, I had to consider that at times of the day I wanted to speak to the whole class. This would be particularly important if I was introducing a new topic, so I may run over or into the time allocated to me. My computer time could be lost as an oversight."

Timetabling was a problem for all schools. It was often the case that teachers would select software simply because it was their "turn" on the computer. He continued:

"During the first year, we were in the dark as to which programs were going to be of any use. We were limited to what was available-what had been supplied. I was familiar with many games. Most of these games I saw as not being of sufficient educational merit to include in a school curriculum. I wanted to get the children familiar with the keyboard and what a computer is and can do. I preferred for them to be doing activities which demonstrated some logical thought. I wanted to keep within the confines of what a

9-10 year old could manage. Within one class, the ability spread could be as much as that of a seven year old to a twelve year old. Another factor to be borne in mind was that some children had their own computer. I find that I am still discovering new programs which I have not tried yet. New programs are being developed all the time."

He finished his notes with the following:

"The parents want it-the children love it, it's up to the teacher to supply it. IT being work on the computer."

Mrs Leaf used three programs, (FARMER, CRASH and FACEMAKER), with her class and had definite aims regarding the use of the computer:

"I use three particular programs with the class at present, aiming at familiarizing them with the computer, using language skills, thinking skills and enjoying the activities."

The development of language and thinking skills, and enjoying activities were included in Mrs Leaf's curriculum before the computer was purchased by the school. The computer has simply extended the range of activities available to fulfil these aims. She too commented on the restrictions of the timetable on her choice of software:

"As I become more familiar with other programs and more aware of how they might help individuals with particular difficulties, I anticipate an extended emphasis into other areas of the curriculum, but at present, its use is somewhat peripheral to the main curriculum. Availability of computer time, class time, teacher time and location of the computer must also have a bearing on this."

Mr Dent, the deputy headteacher during the first year,

wanted his class introduced to the computer, but had little inclination to examine software himself. The class followed a similar programme of computer activities to that of Mr Walker, who was to be the driving force behind the choice of software.

Mrs Jones used the computer in a similar way:

" The aims of a curriculum should be to promote the use of language and thinking, an awareness of the environment, an ability to work with others, and the development of the "whole" child. Most subjects taught can be naturally integrated with one another, for example- History- Drama- Writing. Topic work can envelop a large number of subjects. I feel that the use of a computer can only enhance the development of each child and advance the use of imaginative skills and recording. Valuable work can perhaps be done more effectively on the computer."

She chose most of the software with the above curriculum perspective in mind. Initially, she chose software in order to familiarise children with the computer:

"It is, of course, necessary to learn how to use a computer, how to process information and to show the child that she/he is in control rather than responding to commands from the computer" The first year was a learning time for all. Neither the majority of the children nor I had seen a computer "close up" before and I decided that finding our way around the keyboard would be a good start. Also, how to load programs and correct our mistakes."

During the first term using the computer, she linked the computer to a classroom topic:

"Our main topic for the term was Pirates following a radio music broadcast. Of course, this would cover our Maths- angles, compass bearings etc, English- creative writing and

poetry, History, Geography, Drama etc, and at last a way to add an extra dimension to our work, using 'Spanish Main' on the computer. This was certainly very popular with the children and seemed to reinforce the maths work on angles, direction and bearings."

The second year was spent using software which linked with desirable areas of the curriculum:

" I wanted to use the computer linking it with maths- shape and symmetry etc. Finally, we started working with the Dart program to help us with maths and to learn about giving instructions and working in pairs rather than as in previous terms in groups of four or more. The children began to be more confident and helped each other. Previously, the large groups had been chosen for behaviour reasons. The children coped extremely well solving the problems. Both the boys and the girls showed great interest in using computers other than for games. Perhaps this is all that can be really hoped for when having such a limited time on the computer."

After an initial introductory period enabling children to become familiar with the computer, Mrs Jones attempted to link programs to classroom work. Occasionally the program generated classroom work, for example, the use of Dart. Occasionally, classroom work had already been taking place, for example, the use of SPANISH MAIN. She also commented on the lack of hardware resources as of prime importance when attempting to integrate the computer into the classroom:

"At the moment, sharing the computer with the rest of the school makes it rather difficult to truly integrate it into the curriculum- it is just attached to a particular subject for a short period."

Mrs Lin used the computer during the second year. She

used some MICROPRIMER programs and GRANNY'S GARDEN, mainly as a means of introducing the computer to her class. Her choice of software was influenced by Mrs Harris, and little follow up work was developed in the classroom.

During the first year at Monkham, Mr Thomas introduced the computer to his class using some MICROPRIMER software for keyboard practice. The initial objective was to enable all children in his class to have "hands on" experience of the computer. Having achieved this, he then began to use other software, such as DART and FACTFILE (an information retrieval package).. He used DART in a directed manner, giving children specific tasks to do. All activities involving the use of the computer during this first year were program centred, and involved little related work with children off the computer.

During the second year, he continued to use DART in order to develop mathematical skills, even though all the activities were centred around the computer. That year, he taught a class who were one year younger than the previous year. He introduced the class to word processing using WORDWISE. WORDWISE is an 'open-ended' piece of software, and Mr Thomas used it with reference to written work within the classroom. Also, he used a program called THE WAY WE USED TO LIVE, in order to:

"Extend knowledge in a particular field where this is applicable to work in hand with the class, i.e. History."

Mr Thomas had a considerable personal interest in computers, and this is reflected in the amount of time

spent using the computer, which was considerably more than the other members of staff. The problem of access was not, however, as acute as the other schools because Monkham had two computers. It was noticeable in his class, particularly in the second year, that there was a clique of boys who were very keen on computers, and were involved in writing sophisticated computer programs. These boys were allowed more time on the computer than the others in the class.

Mr Simpson was introduced to the computer by Mr Thomas. He used similar software but with a different emphasis. His scale post carried a language responsibility, and it was to be an emphasis on language which was reflected through the programs he used. He commented as follows:

" I attempt to use the computer in the classroom not as an object in itself, but as a tool. However, some of the early activities used by children have more to do with familiarity with the keyboard and the whole idea of a computer than with particularly meaningful activities, although the more interesting and useful the activity the better"

Here, he has illustrated the initial period of introduction to the computer, which was to last until approximately the end of the first year. Keyboard introduction was achieved through the use of MICROPRIMER software. Mr Simpson became more selective about the type of software to use during the second year, and would use software for different reasons:

"With my younger children, I have used Estimate a little as an activity on its own, and Symmet as an extension and reinforcement of class work on symmetry.... Tray (a text creation program) could prove to be a worthwhile activity and certainly children wanted to do more work with it as the result of a class lesson using it. Storyline (a story creation program) also has proved popular, the small groups of children using it having quite spirited discussions about the ideas thrown up on the screen and ultimately printing their own stories on the printer, a most rewarding activity for them!"

To conclude the uses Mr Simpson made of the computer; he emphasised the importance of including it in the classroom as a tool, and in his particular case, a language tool:

" Most of the work on the computer with my present class of first and second years begins as a class lesson and demonstration to give the children an idea of how to use a given program and then this leads on to small groups (two or three children) working on it by themselves. I keep the computer in the classroom, but not facing the children since this is rather distracting, because the children often need assistance at this stage of their understanding of the machine and its programs. Most of my work with it is in connection with the language side of education and I find this aspect has a most exciting potential."

Mrs Burt introduced the computer to her class through the MICROPRIMER software, in order to develop keyboard skills. After an introductory period of approximately two months, she began to carefully select programs which fitted in with areas of her curriculum. She maintained this selection strategy hereafter:

"I have only used the computer when the programs available have fitted into my schemes of work within a particular area. I have used the Estimation tapes for maths and the Symmet and Shapeb tapes for topic maths. We have used the sound facility to take tunes from recorder books and program them into the B.B.C. I have used the discs associated with the How We Used To Live tv programme and have found them very good. They are a mixture of decision and thought provoking situations."

Mrs Burt usually made her choice of programs from a curriculum centred perspective. She rarely used programs without linking them to other classroom activities:

" I have found the programs valuable when linking them to what is already going on in the classroom. I would not use a program just because it was there, unless it was in free time, e.g lunch or playtime."

Mrs Irons used the MICROPRIMER and SEMERC software (software for children with special educational needs) to introduce the computer to her class. Her main objective throughout the research was to give children practice on the keyboard, and she chose software accordingly. Also, she felt that it was important that children enjoyed their computer activities. She used DART with the older children in her class in a similar manner to that of Mr Thomas, giving pupils structured exercise to do, for practice.

Mrs Franks taught at the school during the first year and briefly introduced her class to the computer using the MICROPRIMER software in order to develop keyboard skills.

Mr Minter, the headmaster, became involved in using the computer with children, particularly during the second year when he was to assume a part-time teaching role.

During the first year, he monitored computer usage closely and displayed enthusiasm and encouragement to his staff. During the first year, he produced a document entitled The Uses of Microcomputers in the Primary School, which was to provide a framework within which his staff could work. This document was produced after staff had already become involved using the computer in the classroom and was largely reflective on the previous months activities. The following extract encapsulates the main points:

"General Aim: To enable children to become familiar with the scope, relevance and simple operation of the microcomputer, and to develop their thinking, planning, problem solving and communication skills. Specific Aims:

1. To encourage greater language precision.
2. To promote clearer understanding of mathematical processes.
3. To foster familiarity with the microcomputer.
4. To encourage greater understanding and discrimination in the use of microcomputers.
5. To enable children to appreciate the impact of computers on the modern world and to be able to accept change willingly, when on investigation that change is for the benefit of society."

All software used by staff incorporated these aims to some extent.

The following areas are mentioned in the document as requiring policy decisions:

1. The allocation of the computer.
2. The allocation of time per pupil.
3. The siting of the hardware.
4. Evaluation of software.
5. The use of additional items of hardware, e.g: Printer,

Turtle.

The Turtle is a piece of hardware which can be used with DART, particularly with younger children. It was not used during the two years.

Finally, Mr Minter produced categories of software within which most programs could be contained:

1. Logo.
2. Problem Solving/Real life simulation.
3. Drill and Skill.
4. Information Processing.
5. Word Processing.

As mentioned previously, he became a part-time teaching head during the second year with a class of middle / top infants. Most of the uses of the computer were centred around language development programs and simple reinforcement software:

" I have found that 'most of our work has been with drill type programs to support special individual needs, e.g Silver used when we were busy with shopping activities to reinforce money."

He generally evaluated his use of the computer as follows:

"The use of the micro with my class has been limited by my dual role of headteacher and half time class teacher. As head, I have felt my role to be that of an initiator, and therefore I have tried to keep abreast of software at all levels. However, in this capacity I have encouraged the use of M.E.P Language Packs 1 and 2, and How We Used To Live. The demands on my time as headteacher have inevitably restricted my capacity as classteacher to initiate work with the micro."

At Sunhill, Miss Jennings used DART almost exclusively with her class. She introduced the computer to her class after attending a county "Leaders" course, where DART activities were developed. She produced a document discussing the integration of the computer, through Dart, into her curriculum. She viewed the curriculum as having five broad areas:

1. social.
2. Language.
3. Maths.
4. Creative.
5. Scientific.

Her use of the computer aided development in the first three areas:

- " 1. Tends to be social- sometimes one child will work on his own, but more often with one or more others. It has encouraged co-operation.
2. Lots of language has come from it- children talking together about what they are doing, or want to do, talking with an adult. So far, a little spelling has come from using the keyboard.
3. Obviously a lot of shape work. Learning to estimate how long to draw or how far to turn the Dart. Younger children have begun to recognise numbers above ten. Helps their number concept."

She continued with DART, mixing free exploration with structured activities.

Mr Winter did not use the computer as often as the other teachers and was continually critical of the software available. When he did use it, it was for a variety of reasons:

" Cat and Mouse. Used this only for a short period. It became a chase to get round the circuit with little educational context. Keyboard practice possibly useful. Spell. Much more useful program as teacher orientated. Able to fit into current language reinforcement. Ability to alter words and timing easily and quickly enable it to be used by all age ranges in the class."

Towards the end of the research, he became interested in using a database program with his class, in order to link it to a class project. The researcher demonstrated the INFORM program to him, and he managed to set up a database with some children, although it was not used for interrogation purposes.

Generally, Mr Winter was rather sceptical regarding the use of the computer in his classroom, since he was not impressed with the software available. Children in his class tended to develop simple keyboard skills and little else.

Mrs Ramble, a peripetetic language support teacher used the computer for short periods of time with small groups of children, particularly for reinforcement work in various aspects of language.

Mrs Walle shared class three with Mr Hart, two days per week. She began to use one particular program from the Microprimer software called ERGO (a program aimed at the development of number patterns). She had seen the program used at another school, and linked it into a classroom topic on number patterns. She used the computer as a tool within a wider classroom context. The program was used exclusively.

Mr Hart introduced the computer to his class by using the MICROPRIMER software. Most early software used had a simple mathematical content and aided the development of keyboard skills. He contrasted this early use of the computer with the use of DART:

"The earlier programs have chiefly helped them become adept at using the keyboard. Dart will help them to develop their own thinking skills and a more adequate understanding of what computers can do."

He linked the use of DART to a wider classroom activity of enlargements. His use of the computer was closely linked to existing classroom practice. It has been used as a reinforcement device mainly for the development of mathematical concepts. This use of the equipment is discussed in the wider school policy document, produced at the end of the research:

"Three microcomputer programs have been found useful in developing work. Dart has developed spacial concepts and helped younger children in their recognition of larger numbers. Ergo has encouraged older children to appreciate and predict mathematical patterns. Shopping has helped to reinforce practical aspects of money work."

During the year at Keeble, teachers devoted almost the entire time to ensuring that all children had some access, however limited, to the computer. Most of the time was spent using the MICROPRIMER software to achieve this.

The majority of teachers, (eight out of fourteen), used the computer for a period of only one week, and were still at the exploration stage at the end of the year. As stated earlier, the main objective throughout the year was to

enable children to have 'hands on' time. Most staff were prepared to use the software which was easily available to achieve this. Few activities off the computer were generated from the use of computer programs.

Summary

Headteachers made the decision to buy a computer without knowledge of the possible applications in the classroom - that came later.

Generally, the responsibility for the computer equipment was given implicitly to a member of staff, usually a member of staff who was interested in using it.

The responsible member of staff introduced the computer into the school (except Sunhill where no member of staff was responsible for it), and usage gradually permeated the school.

Where possible, the computer was situated close to the class using it, usually within the classroom. Middleton was the exception where there was a specific computer room where children had to travel to use it.

All schools had software supplied in the form of the MICROPRIMER material. In addition to this, software was obtained from all sources available, namely Hamble College, County, software houses, and, in the case of Keeble, a pupil.

Software was used for a variety of reasons. The main theme to emerge from the four schools studied for five terms was that teachers became more discriminating about software as they became familiar with it. Also, after an

introductory period, teachers tended towards the more curriculum based 'open-ended' software.

The flowchart contained in figure 8 (page 59) provides a useful framework for schools contemplating the purchase of further computers

Chapter 6

A detailed focus on four teachers' perceptions of software.

The discussion at the end of the last chapter provided the researcher with a starting point for investigating the sense teachers made of the computer in the classroom. Teachers comments were exclusively about the use of the computer through software. The researcher decided to 'home in' on four of the teachers concerned and adopt a structured approach to investigating their application of the computer. He used repertory grids as a technique for the investigation. Such an approach amplified the second aim of the research, that of the investigation of the detailed application of the computer. This technique provided an internal focus for the research by illuminating individual teacher perspectives on the software they used. This contrasted the external (organizational) focus of 'the Schon model.

Lampert (1985), discussed reasons for focusing on the teacher:

"The teacher's emphasis on concrete particulars in the description of a classroom problem distinguishes the perspective of practice from the perspective of the theory-builder. This distinction has received considerable attention in the literature on teaching. Another fundamental though less familiar difference involves the personal quality of teaching problems as seen through the eyes of a practitioner. Who the teacher is has a great deal to do with the way she defines problems and what can and will be done about them....Even though the teacher may be influenced by many powerful sources outside herself, the responsibility to act lies within. Like the researcher and the theoretician, she identifies problems and imagines solutions to them, but her job

involves the additional personal burden of doing something about these problems in the classroom and living with the consequences of her actions over time".

A local focus on the teacher was to illuminate the teacher's position with regard to what Stenhouse (1975), referred to as a 'Teachers as Researchers' curriculum development model. This involves the teacher accepting a proposal on provisional trust - in this case, the introduction of the computer - and making sense of it through use within the classroom. Young (1965), argued that innovation and research should be closely linked:

" Without research, innovation will remain subject to fashion, liable to be swept away by the next enthusiast who can present his proposal with a show of charismatic brilliance"

The repertory grids were to illuminate teacher perspectives through the translation of the innovation into use in the classroom. Also, individual teachers' views on software would emerge, since it was software which enabled teachers to use the computer in the classroom. The 'fashion' element of innovation was to ultimately emerge through the grids.

After the fieldwork had ceased, the researched schools were re-approached in order to use the repertory grid technique. Both dyadic (where participants have to contrast two elements) and triadic (where they have to put two elements together, contrasted with a third) techniques, of repertory grid elicitation were investigated by the researcher. The elements were computer

programs, and the constructs were the feelings teachers had towards particular elements. Initially, Keen and Bell's dyadic approach through a computer program, as discussed in Pope and Keen (1981), was examined and found to provide insufficient stimulus for the teachers taking part because of the ambiguities in the terminology of the program. For this reason, the researcher investigated the triadic approach as designed by Kelly (1955), and decided to elicit constructs for the grid from the teachers, rather than providing them himself (Keen and Bell's computer program also elicited constructs, but was ambiguous when used). Kelly argued that constructs have to be useful and meaningful to the teacher and representative of the individuals' life events. Elicited constructs have more chance of achieving this end. To investigate the way individual teachers construed the application of computers in their classrooms, the researcher felt that all taking part in the repertory grid investigation should begin with the same terms of reference, namely an initial input from the researcher with the intention of stimulating thought. This input was in the form of a question:

"What uses have you made of the computer in your classroom?"

The time available to the researcher was all important, as well as access to the teachers taking part. Both full time teachers at Sunhill were to leave the school at the end of the summer term, 1985, to take up posts outside the

Hamble area. Consequently, any such participation in repertory grids would not have been valid since both elements and constructs may have referred to the uses of computers in their new posts. Also, the staff at Keeble were not to have regular use of the computer throughout the week and hence very little 'hands on' time for both staff and pupils. This was a consequence of the headmaster stating his initial objective of giving every child some time with the computer, which was achieved by allocating the computer on a weekly basis to each class. The size of the school was to mean that each class had the computer one week in fourteen. The researcher was keen to gain an insight into teachers' thoughts regarding software once they had used the material for a considerable time in the classroom. Supporting this lack of 'hands on' time was the late arrival of the computer to the school, which was to shorten the research period. For these reasons, it was decided to concentrate the repertory grid investigation on the other two schools, Monkham and Middleton, who both had computers from the beginning of the period, and also had a stable staff with little change. As far as is known to the researcher, this is the first use in this country of repertory grids for evaluating computer software.

The grids were elicited nine months after the observation sessions undertaken by the researcher had ceased. Consequently, software used after this period was to emerge through the grids and was to provide a valuable insight into the way teachers viewed software nine months on.

The researcher has used the grids to provide a framework for a discussion with individual teachers. Having constructed the grids with the teachers concerned, he realized that the discussion which had taken place was as important as the data contained in the grids. As a result of this, he has used this section to illustrate the thoughts teachers had towards software and its use in the classroom, and has placed the focusing techniques used on the grids in appendix 2. The final focused grid is contained in this chapter, immediately prior to the discussion.

Grid Analysis.

As discussed previously, the grids were elicited to examine both the way teachers construe the uses of computers in their classrooms, and their views of the software they have used in the classroom. Without exception, all elements of each grid were items of software, so constructs were focused on the feelings teachers had towards the software they had used. Individual grid analysis has been standardized by the researcher. Elements and constructs were suggested by the teachers taking part, and not imposed by the researcher.

The classes taught by the teachers during the two years are in brackets, year one first.

Grid One: Mrs Harris, Middleton. (4th/4th Junior).

The computer was situated in a room adjacent to Mrs Harris's classroom. Initially, she was to share the use of the computer with Mr Walker. By the beginning of the second year of the research, a computer timetable was introduced by Mrs Harris (who had implicit responsibility for the computer) as a result of an increased demand from other members of staff to use the computer.

The following elements and constructs were elicited from Mrs Harris:

Elements.

1. Familiarization Software.
2. FLOWERS OF CRYSTAL.
3. MATHEMATICAL GAMES AND ACTIVITIES.
4. GRANNY'S GARDEN.
5. DART.
6. Children's own programs.
7. Early Learning Pack.
8. M.E.P. Software.

Constructs.

- a. Few decisions necessary / Many decisions necessary.
- b. Final results variable / Final results constant.
- c. Elements of rote learning of basic educational ideas /
No elements of rote learning of basic educational ideas.
- d. No longer useful / Useful.
- e. Pupil preparation necessary / Pupil preparation not so necessary.
- f. Mathematical bias / Non mathematical bias.
- g. Computer activity initiated because of the computer program / Computer activity initiated because of classroom topic.

The data contained in the grid relates to the weightings given to the constructs. For example, a rating of 1 for the element 1. Familiarization software,

software since the initial injection from the M.E.P, (element 8). This improvement, she felt, was based upon the nature of the emerging software and its relevance to the child. Consequently, her ratings for all software through this construct are at both poles.

She highlighted, through construct g, computer activity initiated because of the computer program/ computer activity initiated because of a classroom topic, two distinct applications of the computer, and two stages of development:

Stage One. The introductory period of using the computer in the classroom. She described this period as the time when most computer usage was generated by the software available. Computer-based work was free standing, with little or no link with existing classroom activities. This introductory period was to last approximately until the end of the case study research, five terms in total.

Stage Two. Having familiarized both herself and the pupils in her class with the computer, usage of it was to occur now so as to back up and reinforce an existing classroom activity. She mentioned three particular uses of the computer as being applicable to this stage. DART and MATHEMATICAL GAMES AND ACTIVITIES (elements three and five), are pieces of software which she says have developed and reinforced mathematical concepts. Children writing their own programs, (element six), has been a use of the computer which has developed skills in co-ordinate geometry. These three applications of the computer have

ratings of totally useful and are generally mathematically biased, (construct f). Also, these applications contain few elements of rote learning, and some preparation of work before computer activity can occur. Consequently, the three applications are clustered together in the grid. All computer activity currently taking place in her class is now at stage two.

Grid Two: Mr Walker, Middleton. (3rd/3rd Junior)

The elements and constructs elicited from Mr Walker were as follows:

Elements.

1. GRANNY'S GARDEN.
2. MATHEMATICAL GAMES AND ACTIVITIES.
3. PODD.
4. ARCHAEOLOGY.
5. MATHS WITH A STORY.
6. MICROPRIMER.

Constructs.

- a. Graphically interesting/ graphically not so interesting.
- b. Generates pupil interest over a period of time/ only of immediate use.
- c. User friendly/ not user friendly.
- d. Teacher needs to be involved when using the program/ teachers need not be involved when using the program.
- e. Sustains interest/ Does not sustain interest.

The final focused repertory grid.

(1)

	g	m	m	a	m	p	
	1	2	6	4	5	3	

(5)

user friendly	-	3	5	5	0	2	2-	not user friendly
generates interest	-	3	4	5	1	1	3-	immediate use only
graphic interest	-	2	4	4	3	2	1-	no graphic interest
needs teacher	-	4	4	3	2	3	4-	teacher not needed
sustains interest	-	2	2	3	1	4	4-	unsustained interest

Information elicited from Mr Walker's grid.

Mr Walker was prepared to use a variety of software with children. Unlike the other teacher grids, his tends to illuminate a flexible view regarding the software he has used, (only seven out of thirty scores of either one or five.)

He had an art bias in the classroom, which is reflected in construct a, whereas his choice of construct d, teacher needs to be involved when using the program/ teacher needs not be involved when using the program, reflected the location of his classroom in relation to the computer, i.e a distance away from it. If he was needed at the computer when a member of his class was using it, then it would be at the expense of the rest of the class.

As with most other teachers, he declared the MICROPRIMER software as being of only immediate use, and not being user friendly.

Grid Three: Mr Thomas, Monkham. (3rd and 4th/ 3rd Junior)

The elements and constructs elicited from Mr Thomas were as follows:

Elements.

1. HOW WE USED TO LIVE.
2. GRANNY'S GARDEN.
3. TRAY.
4. Word processing.
5. FACTFILE.
6. DART.

Constructs.

- a. Adventure Software/ non-Adventure Software.
- b. User in control/ user not in control.
- c. Decision making/ none decision making.
- d. Random/ positive.
- e. Pupil controlled/ program controlled.
- f. Not very relevant to primary practice/ relevant to primary practice.

The final focused repertory grid.

	(1)	d 6	w 4	t 3	f 5	h 1	g 2	(5)
decision making	-	0	0	3	3	1	2-	non decision making
user in control	-	1	1	1	1	2	4-	user not in control
pupil controlled	-	4	1	1	2	4	4-	program controlled
random	-	5	5	5	5	3	2-	positive
irrelevant	-	5	5	5	5	4	1-	relevant
adventure program	-	4	5	5	5	2	1-	non adventure prog.

Information elicited from Mr Thomas's grid.

Mr Thomas was interested in the control aspect of computers through the two constructs b and e, i.e user in control/ user not in control, and pupil controlled/

program controlled.

He made reference to the processes children have to go through when using a particular piece of software through construct b, user in control/user not in control, and whether or not the child has any influence with reference to the outcome. Construct e, pupil controlled/ program controlled, referred to the nature of software and its ability, in the case of word processing, to be 'open-ended' and enhance existing work within the classroom. Construct f, not very relevant to primary practice/ relevant to primary practice, has a close relationship with constructs a and d, which serves to illustrate the way he thought about relevant software for use in his classroom- most relevant material tends to be non-adventure in nature and has positive (i.e strict program rules) elements. Most of the material being used at this time was similar in nature to that used by Mrs Harris in that it was generally material which backed up existing classroom activities, whereas^e during the period of the classroom research, he was prepared to experiment with software in the classroom in order to develop a useful software strategy.

Finally, he had definite views regarding software- 19/36, i.e 53% of his ratings were either one or five.

Grid Four: Mr Simpson, Monkham. (3rd and 4th/ 1st Junior)

The elements and constructs elicited from Mr Simpson were as follows:

1. SYMMET.
2. WORDWISE.
3. TRAY.
4. DART.
5. FACTFILE.
6. ANAG.
7. ESTIMATION.

- a. Linguistic/ mathematical.
- b. Group activity/ individual activity.
- c. Preparation required/ preparation not required.
- d. Open ended/ not open ended.
- e. Non-repetative/ repetitive.

(1)		w	f	d	t	a	e	s		(5)
		2	5	4	3	6	7	1		
linguistic	-	1	2	4	1	1	5	5-	mathematical	
open-ended	-	1	4	1	3	5	5	5-	not open-ended	
non-repetitive	-	1	3	3	4	5	5	5-	repetitive	
preparation needed	-	1	1	4	5	5	4	3-	no preparation	
group activity	-	2	2	2	3	5	4	3-	individual	

Nineteen out of thirty five, (i.e 56%), of Mr Simpson's ratings were definite, i.e either one or five. Mr Simpson spent most of his computer time using language based software- he had a scale post for language. Also, he tended towards the more open ended software as he grew in confidence in using the computer.

Summary

There were two reasons for choosing the four teachers concerned to take part in the grids. Firstly, they taught at the two schools that were similar in size with respect to the number of classes. Ultimately, this was to mean that the way the two schools organized the introduction of the computer was similar. The nature of the introduction is discussed in detail in the case-study chapter. Secondly, the four teachers were involved in the introduction of the computer from the beginning of the research, two of them having implicit responsibility for the computer. The grids served to focus on the sense the four teachers made of the software available to them for use in the classroom.

Mrs Harris's grid illustrated a transition from her own exploration of the computer, stage one, to use within an existing educational framework, stage two. The same was the case with Mr Thomas, who at the time of the grid elicitation was using 'open-ended' software almost exclusively. As Mr Simpson became more aware of the facilities of the computer, then he tended towards the same type of software. Mr Walker was prepared to experiment with software during the entire research period, and at the time of grid elicitation was tending towards software with an art bias.

One common factor was that all four teachers were prepared to experiment with software in the hope that children would become familiar with the computing

equipment. As this familiarisation occurred, then they tended towards using the more 'open-ended' software which related to a particular classroom activity, away from activities which were solely generated by the computer. Such activities include information retrieval, word processing and DART. These findings are similar to those of the study discussed earlier by Jackson, et al, (1986).

Finally, although the grids involved only four teachers, they could supply evidence of a trend in primary school computing. As teachers become familiar with software, their confidence in using the computer with children increases, and they gradually use the computer as an educational tool, through 'open-ended' software. Such developments may be a necessary stage of staff development, and formed the framework of the researcher's computer training programme run at Hamble College.

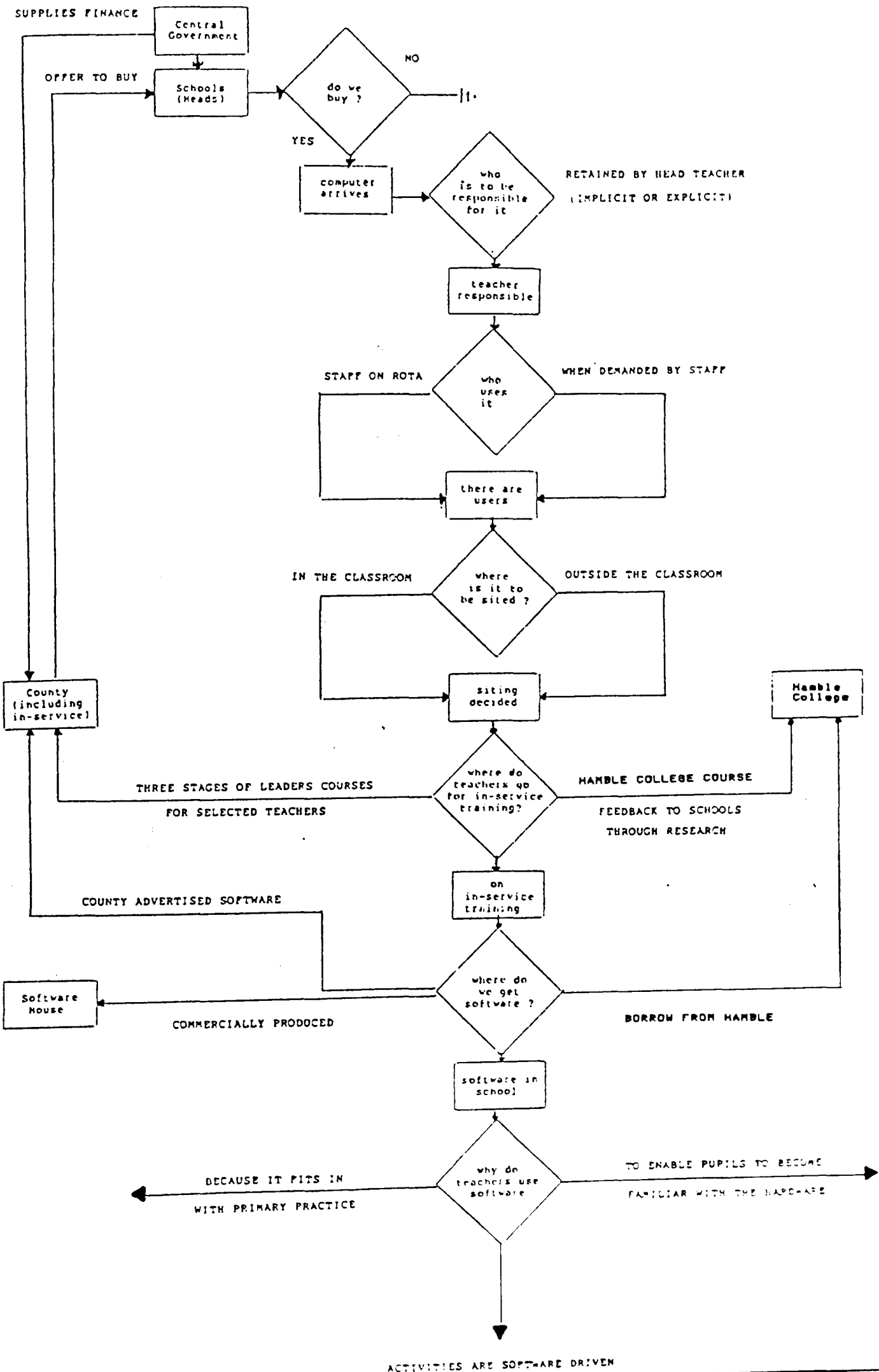
Chapter 7.

Teachers' computer training needs.

Schools in the Hamble area began to place orders for their sponsored computers during the Spring term, 1983. It was during this term that the researcher took up employment at the college. Also at this time, primary schools were being offered finance to buy one microcomputer system. At this time, there was no official county in-service programme- this came after schools had purchased their computers. Also, there was no official county policy for computing in primary schools at this time. Such a policy was developed and finally communicated to schools three years after schools^{had} begun to purchase computers. The researcher decided to investigate the possibility of setting up an in-service course for the start of the summer term, before schools received their computers, by writing to local primary schools to find out if such a course was desired. The response was overwhelming, with enough schools responding to enable two parallel courses to be initiated for the beginning of the summer term.

Ultimately, teachers were to make another decision in the same way as they made six key decisions in the flowchart on page 59. This particular decision regarding in-service training is illustrated in the full flowchart in figure 9.

Figure 9
Full flowchart of key decisions made by schools.



The Hamble College Programme.

The researcher informed the Inspector responsible for overseeing the introduction of microcomputers of the courses. He was to become involved with the content of the courses.

One important issue raised by the instigation of such courses is the role played by further education, in this case, a technical college, in vocational education. The researcher viewed the provision of courses for local teachers as vocational in the same way as the instigation of a course for local industry. The running of these courses fell within his job description just as any vocational course in a computer related area.

Before these courses were to take place, the researcher had to ensure that the content of the courses reflected a range of software that was available to primary schools. The researcher had initially designed the courses around two pieces of software- a version of Logo, and an Information Retrieval package called FACTFILE. At the time, little software was available for use in primary schools, so deciding on applicable software was not difficult. Also, he knew that the two activities were desirable for primary school teachers, since he had previously spoken to the Inspector regarding suitable software. Although there was no official county policy on software at this stage, the Inspector suggested that the most useful activities came with the use of 'open-ended' software. Ultimately, the researcher met with the Inspector and the content of the

courses was agreed. Having the support of the Inspector was subsequently reflected in funding for the courses from county.

Primary school computing was a completely new area to both the teachers taking part in the courses and the researcher himself. During the courses, he was to often remind the teachers that he was simply making available computer hardware and related software for them to be able to form their own opinions regarding the suitability of the material, i.e the pedagogic and curriculum choices and decisions were the teachers. Many headteachers taking part in the courses were in a similar position. They had decided to buy a computer, often in consultation with their staff, without knowing to what uses they were going to put it. In short, the decision to buy a computer was not based on educational grounds, it was based on external financial inducement- an offer from the Department of Trade and Industry to supply one half of the cost of one complete hardware system (this was the 'Micros in Schools' scheme). Many teachers taking part in the courses were unaware of possible applications in the primary school.

Initially, the courses centred around 'product' evaluation- enabling teachers to familiarize themselves with the programs available. it was not until the research in schools commenced during the autumn term, 1983, that trends began to emerge regarding the use of software with children. The researcher was in a position to observe these trends since he was a participant observer in four schools.

Also, teachers taking part in the courses often shared their experiences with the group, thus enabling the researcher access to activities in schools outside his research. The researcher began, gradually, to introduce an educational / theoretical content to his courses as a result of this information. This approach is based within 'Grounded Theory', Glaser and Strauss (1967). Grounded Theory suggests the development of educational principles and objectives as a result of research, and not as a prerequisite to research. This had to be the case- this was the time of the introduction of microcomputers. A learning time for all concerned. The researcher was an agent for disseminating information regarding primary school computing which he was continually developing through interaction with teachers taking part in his research and attending his courses.

The initial courses, as discussed above, were as follows:

Course Title: An Introduction to the Uses of Computers in the Primary School.

Length of Course: 5 weeks, 1.5 hours per week, 4.30-6.00pm.

Content:

Week

1. Logo (Computer Concepts version)
2. Logo.
3. Logo.
4. Information Retrieval (FACTFILE)
5. General Software, e.g Games, simulation.

This course outline was to remain until Christmas, 1983,

when the Logo software was to change to DART. The researcher decided to change from the Computer Concepts version to DART for two reasons. Firstly, many schools were receiving DART as a piece of software from county, and would be able to relate the course to practical work within the classroom. Secondly, DART was a county supported piece of software, and since the courses were being funded by county, (teachers did not pay fees), the researcher decided to reflect the county attitude towards software by using such approved material, where possible.

Course developments.

By the autumn term, 1983, teachers began to suggest that the researcher should run further courses which could extend the work developed on the initial courses. He satisfied the demand by instigating a follow up course on computer programming. The course lasted a complete term, 1.5 hours one evening per week. Most aspects of computer programming in BASIC were covered, with particular reference to sound and graphics.

Few teachers were to use this recently acquired knowledge of BASIC to introduce children to computer programming, although Dart was in use in many schools. It was during this part of the year, (Summer 1984), that considerably more software was being developed by both county and commercial software houses. As a result of this, the researcher decided to replace the programming courses with software-based courses using much newly developed software. The new follow-up eleven week course outline was

as follows:

Week

- 1 Information Retrieval (INFORM).
- 2 Information Retrieval
- 3 Information retrieval
- 4 Word Processing (WORDWISE).
- 5 Word Processing
- 6 Word Processing
- 7 Language Software.
- 8 Language Software
- 9 Adventure Software.
- 10 County Produced Software.
- 11 M.E.P Material.

This course outline again represented the Inspector's view of suitable software for the primary school. It was not radically different from the initial courses, but enabled teachers more time to evaluate newly developed software which came within the 'open-ended' framework, as previously discussed was deemed desirable within this county.

There are many Information Retrieval packages available for use in schools. INFORM was chosen because it was a county recommended package. The WORDWISE chip was chosen for the Word Processing sessions because it was available in most college computers, even though there was little word processing taking place in schools at this stage. The rest of the material was chosen for use on the courses because it provided examples of other applications of

'open-ended' software. This follow up course framework was to remain until Christmas, 1984.

It was at this point in time that the researcher decided to offer only one- term courses. The demand for the introductory courses was reduced, as expected (teachers were gradually becoming aware of the material contained in the introductory course as they used computers in school). These one-term courses were slightly modified to include DART, which was previously introduced on the introductory course. Other software was used as it became available.

Comments on school involvement in the Hamble College Programme.

All research schools applied to attend Hamble College courses. The development of in-service attendance was as follows:

Middleton.

Number of Teachers attending at least one college course: 6/8. (4/5 junior teachers, since the computer was not used in the infant classes).

Most teachers attended at least one course, although three of the four Junior teachers attended early on in the programme, which was to mean that they were not to see the more recent software in use in schools. This, of course, was a problem for all schoolteachers- the ability to remain up to date with computer software.

Mrs Harris (the teacher with implicit responsibility for the computer), was to frequently borrow software for

inspection and subsequently the school were to purchase much material. FACEMAKER was borrowed on extended loan and was to be used by the first year teacher for a considerable part of her computer time. Mrs Harris invited the researcher into the school towards the end of the first year in order to direct a session with her class involving GRANNY'S GARDEN. She was to subsequently buy this software and the more complex FLOWERS OF CRYSTAL program for the school and devote more than one complete term using it. The staff at Middleton had no contact with the county 'Leaders' programme. None were invited by the Inspector to take part.

Monkham

Number of teachers attending at least one college course:
5/5.

All staff attended one introductory course and one follow-up course during the first year. All staff were to subsequently attend the second phase of the follow up courses. Both the headmaster and deputy headmaster were actively involved in the in-service programme and were always looking to secure software for use in the school. The M.E.P. produced much software which was freely copyable for use in schools, and Mr Thomas in particular took every opportunity to copy such material.

Sunhill.

Number of teachers attending at least one college course:
3/3. Number of teachers attending 'Leaders' programme:
1/3.

All three staff attended the introductory course. Mr

Winter and Mr Hart attended the first phase of the follow up course. In addition to this, Miss Jennings was to be the only teacher taking part in the research to be selected by county as a 'Leader'. She was to attend the county courses in addition to the college course. The headteacher was under considerable pressure upon the arrival of the computer as a result of the initial lack of interest from the other two staff. With the exception of GRANNY'S GARDEN and a brief look at information retrieval, Mr Winter did not see other software to change his attitude towards the use of the computer in the classroom. He was not particularly interested in using it.

At the time of the introduction of the computer into the school, the researcher introduced some children to DART and FACTFILE (at Mr Hart's request). Mr Hart subsequently devoted considerable time to DART during the research period.

During the second term of computer usage, Miss Jennings introduced the computer into her infant class. She had attended the first phase of the county course, which was an introduction to DART. She was to subsequently devote virtually all her computer time to the use of DART. For her, the use of DART was a method of integrating the computer into her classroom. The researcher observed the computer in use with DART at different times of the school day with different children, thus providing an integrated activity within the classroom.

Keeble.

Number of teachers attending at least one college course:
11/14.

The school computer arrived nearly twelve months late, by which time more than half the staff had attended at least one course. The research was to cover the first year of implementation of the computer in the school and was viewed by the researcher as an introductory period.

As discussed in the chapter 5, the headmaster produced an outline policy with regard to the computer, and this school was the only one to produce written guidelines regarding use within the classroom. The choice of software (by teachers) for use in the classroom was related to the two main objectives of the introductory period, namely:

1. To include the use of the computer in the daily process of the integrated approach.
2. To enable all the children in the class to gain confidence in the use and handling of the computer.

Most teachers were more concerned with ensuring that all children had some 'hands on' time, rather than carefully selecting software for use. MICROPRIMER software was close at hand, along with the Welcome tape (an introductory tape distributed with every B.B.C computer purchased), and it was this software which was used the most.

The in-service courses provided the researcher with time to talk with teachers outside the classroom/school situation. One underlying theme which was to emerge through teachers in general was one of pressure and expectation

from various sources to implement the hardware in the classroom.

Teachers generally had little knowledge regarding the maintenance of a microcomputer system. A system was set up within county to maintain hardware, but few teachers taking part in the research were aware of the necessary channels of communication. Several teachers commented that they had not received documents from the County Advisory Service informing them of the necessary channels. This may have been the case, although often documents are displayed in staff rooms which may not have been read by teachers. As a result of this, the researcher was often called upon to resolve minor problems with hardware. The same applied to software. Teachers were to corrupt discs frequently, and ask the researcher to repair them.

Often, teachers enquired about new software coming onto the market. There were no facilities available through central county for teachers to be able to review such software. The researcher set up several sessions for teachers to effect such an evaluation outside of his courses.

Finally, the researcher has produced a guidelines sheet in figure 10, which illustrates the conditions he suggests are necessary for an in-service course to be successful. The sheet has evolved as a result of his experiences of developing such courses.

Figure 10

Guidelines for In-Service Training in Microcomputers.

1. An in-service course needs to be local to the teachers taking part, i.e easily accessible after the school day.
2. Hardware and software resources contained in the institution running the course need to be substantial, e.g two teachers to one microcomputer.
3. Courses need not be prescriptive. Teachers need to be encouraged to incorporate the use of the computer into their existing classroom situation. Such an approach enables in-service courses to be relevant to teachers with little confidence, and often, such teachers develop to consider the possibilities of using 'open-ended' software.
4. Teachers need to be kept up to date on software research in the classroom. This can be achieved by making all kinds of software available to them through the course.
5. Teachers need to be able to apply work undertaken on an in-service course in the classroom, however limited their hardware resources.

Summary

The researcher provided courses for teachers which were 'open-ended'. He made time available for teachers to evaluate current software in order for them to develop a perspective on how best to use the computer in their working environment. He made all kinds of software available, not just county recommended software. His philosophy in running the courses was that teachers should form their own opinions regarding the usefulness of the computer. He regarded this as vital since schools had varying degrees of hardware and software resourcing. As teachers began to use the computer in the classroom, then he encouraged them to share their experiences with other course members through feedback. The courses were perpetuated by this cyclic process.

Chapter 8.

County Courses in Computing for Primary School Teachers.

At the time of the introduction of microcomputers, a County Inspector was given the responsibility of overseeing the introduction and making teachers aware of what county, through him, believed was good educational use of the computer. Much of the work associated with this was developed through the Primary Advisory Staff, situated at the Advisory Unit in the county town. It was both the Inspector and the Advisory Staff who, during the autumn term, 1983, developed courses for teachers entitled "Primary Teachers Computing Development Leaders Course", referred to as the 'Leaders' programme in the previous chapter. The reason behind the county in-service programme was outlined by one of the County Advisory Staff as follows:

"Our approach at county has been to involve good primary teachers in a series of courses aimed at enabling them to then run courses themselves in their local areas under the auspices of the Teachers' Centres"

He outlined the content of these courses to the researcher, towards the end of 1984. There were three phases of 'Leaders' courses:

Phase 1. An introduction to Dart and BBC Basic through graphics and file handling.

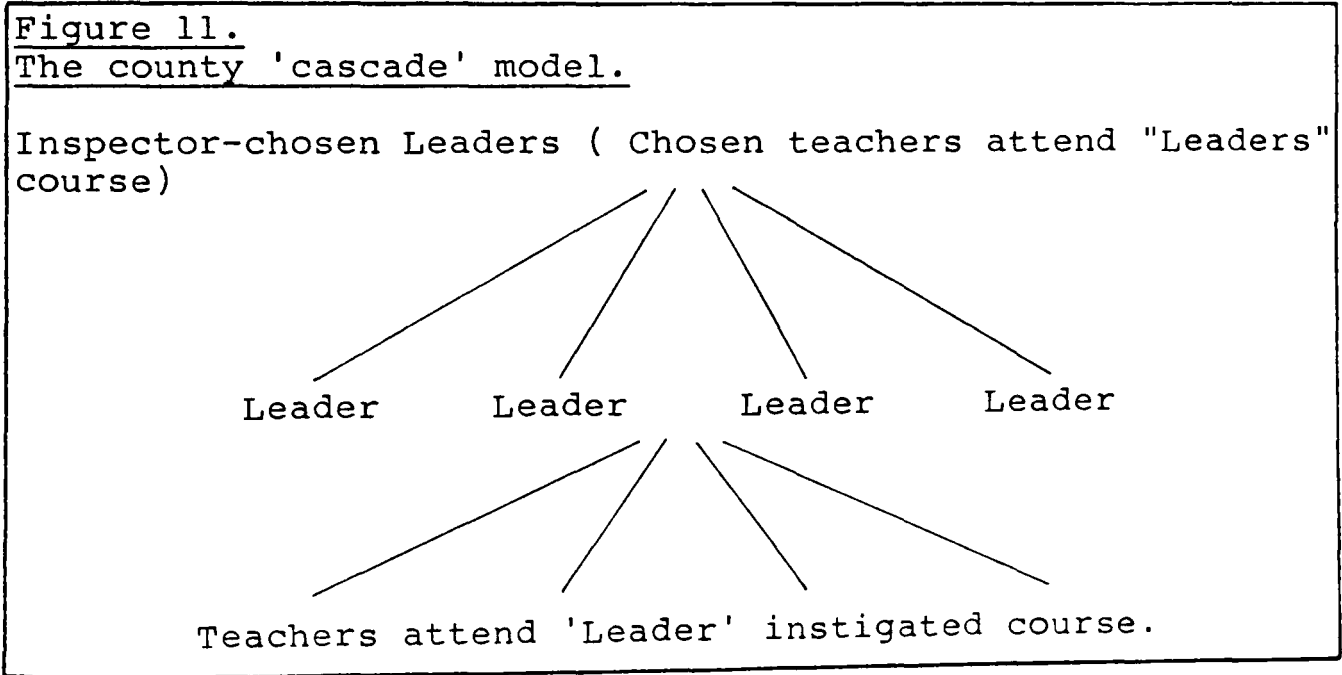
Phases 2 and 3. The application of software such as INFORM, various Word Processing packages, Language Software, Adventure Software and Control Software.

Teachers were selected for these courses by the

Inspector and the Advisory Staff. A member of the Advisory Staff, a Primary Adviser in Computing, stated that they were teachers with 'sound curriculum direction who could be relied upon to develop good work'.

It was intended by the Inspector and the Advisory Staff that such 'Leaders' would subsequently run their own in-service courses in their local areas. At least one course was set up by a 'Leader' at the Hamble Teachers Centre. The one Leader taking part in this research, Miss Jennings, did not run any 'Leaders' courses during the period of the research.

The County 'Leaders' programme was selective. It was dependent on a two-tier system of information dissemination, based on a 'cascade' model similar to the Schon model chosen by the researcher, as illustrated in figure 11:



County 'Leaders' courses were run by advisory teachers and tended to be centred around county sponsored software. The courses were collaborative in that the course tutors

and course members shared experiences with software so as to formulate principles regarding the implementation in the classroom. Course members were expected to run local courses using county sponsored software.

During 1986, the Senior County Inspector for Computers in Education (a new appointment, not the Inspector previously mentioned) approached the researcher through Hamble College. The Inspector commented that the 'Leader' programme in the area was now non existent since the local leaders were 'inactive' - that is, they had not instigated courses at the local teachers centre. A reason for this may have been that the leaders in the local area all attended the researcher's in-service programme, discussed later. Two of the three leaders concerned suggested to the researcher that they did not know enough detail to be able to instigate such a course (this was a reason for them attending the researchers' course). The Inspector was concerned that little other work was taking place. He identified some teachers who he felt might be of 'Leader material', and suggested close liason between these teachers and the researcher in order to instigate further in - service training. This liason took place and the Inspector has now deemed the researcher as a 'Leader', implying that his courses now form part of the 'Leader' programme. It must be remembered, however, that these course developments took place before the change in both the conditions of service of teachers and the nature of in-service training under G.R.I.S.T.

Finally, the researcher sent a copy of this chapter to the Senior Inspector for Computers in Education for his comments. His reply is contained in figure 12.

Figure 12

The inspector's comments

Dear Terry,

Thank you for your letter of 20 January and the enclosed extract from your research thesis. I am pleased that you will be able to attend the Leaders' programme, and while I will not be there for much of the time, I look forward to seeing you at the start of the workshop.

I think your paper is, on the whole, fair and accurate insofar as the comments relate to the in-service provision in the Hamble area. I fully agree with you that in-service education can only be effective if it is conducted in a location which is close to the place of work of a teacher and which has adequate resources. The initial area-based County courses were as close as possible to the location of teachers (they were area-based), but of course a real disadvantage was that teachers had to bring their own equipment. Increasingly, we have been able to work in conjunction with other establishments - for example, Colleges - and one would endeavour to ensure adequate resourcing for course locations in the future. However, where courses are restricted to teachers' centres, there will always be a real problem with regard to access to equipment.

As you will appreciate, we were always very keen to give guidance to teachers on how computing could extend and link with good primary practice. I am convinced that the basis of in-service should be educational and hence, the pattern of our courses; in principle, we identified activities which would take place within the primary classroom which could be extended by various computing applications (Information retrieval, word processing, control, etc.)

/continued

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The intention was never to be prescriptive about what would happen in the primary classroom with regard to computing, but rather to set the scene and give a lead to teachers so that they could make decisions about other software from a position of some experience and knowledge. I think that this must always be a point of debate, but I don't think anyone is suggesting that any one course is the only, or 'right' one.

My feeling is that, on the whole, the Leader programme has been successful so far, but not without its faults and we all learn as we proceed. The main exception, of course, is the apparent failure of the Leader scheme to take off and deliver courses in the Hamble area. Were your courses successful, I wonder, because the Leader scheme did not take off in Hamble or did the Leader scheme not take off in Hamble because of the success of your courses? As you will know, we are shifting the emphasis of the leader-led teachers' courses from the 'baseline' series to application specific - that is, courses on the uses of particular packages and computer applications within the primary curriculum. I see a further development of this to lead into the extension of general courses on primary topics to include computing applications.

With regard to software, the two main criteria are open-endedness and relevance to good primary practice. So an information retrieval package would be relevant because information handling is a major activity in primary schools and such an application can be seen to enhance this process; some packages are less restrictive and more open-ended than others so, for example, Factfile ~~was~~ seen to be less appropriate than Inform and Quest. In the past, we have preferred Inform to Quest on the basis that the former was more user friendly. However, many primary school teachers said they preferred to use Quest with their pupils and many secondary school teachers said they preferred Inform; today, we don't really draw any distinction between the two with regard to primary computing. Increasingly, therefore, the Authority will support content-free software that is usable and relevant for primary schoolchildren.

I am not sure what you mean by 'my responsibility to the Leader programme'. I am committed to its continuation, and have made it a top priority in the future in-service education programme for computing. As to its format and the process and content of courses delivered by leaders, this is the responsibility of the Inspectorate (myself in consultation with Mr. Jones), that is achieved in discussions with the advisory teachers, the Primary Panel, and the leaders themselves, drawing largely on feedback from the teachers who attend the variety of courses.

With regard to your recommendations on pages 121

(1) I agree fully.

(2) This depends on the nature of the course. A course requiring total or a major amount of 'hands-on' use of a computer clearly requires a significant amount of computing resourcing.

On the other hand, courses aimed at developing confidence in the use of computing as an aid to other major activities should, perhaps, reflect the likely level of resourcing in a typical classroom at any point in time. Therefore, if a course is on how desk top publishing packages may contribute to a broader topic, then it would be more appropriate to have the teachers' experience the kind of learning and practical environment that their youngsters will also experience.

- (3) I agree that courses certainly should not be prescriptive, but especially at the early stages they need to have a well-defined structure if the aim is to give teachers an appreciation of the nature of the computer applications possible in the classroom. As teachers gain experience and confidence, then course structures can be increasingly open-ended. If, on the other hand, you call a course 'prescriptive' when it is aimed at using one or two particular packages as the vehicle, then this will have to be the case for some time. I am thinking, for example, of a course on desk top publishing - Pagemaker and Fleet Street Editor will have to be the basis of that course.

(4) Agreed.

(5) Absolutely!

Perhaps I can sum up my own objectives for the in-service provision in computing for teachers. This is that teachers should be supported and encouraged to achieve a creative, imaginative and meaningful use of computers by their youngsters in the classroom to significantly and appropriately enhance their learning. The Leader programme is a vehicle (and probably the only vehicle at this point in time) to enable as many teachers as possible to attend courses to help achieve this objective.

I certainly would welcome the opportunity to discuss further your ideas and thank you for writing. I hope you find the residential course of use and I expect that you will make a number of contributions direct yourself.

With best wishes,

Yours sincerely,

Senior County Inspector
(Computing in Education)

Summary.

County courses for teachers were prescriptive. The inspectorate viewed the computer as a tool to develop their view of the curriculum through the use of 'open-ended' software. The content of the researcher's programme was similar to the county courses. One important difference between them was that his courses did not prescribe the use of 'open-ended' software, as did county courses. If teachers introduced such software into their classrooms, it was because they felt there was a place for it with the hardware and software resourcing available to them.

During the research period, the D.E.S were in the process of formulating and disseminating the idea of a basic curriculum in the primary school. A written document was produced entitled The Curriculum From 5 To 16, D.E.S (1985), which included the use of the computer within a basic curriculum. The document suggested that the computer should be used as a tool, in an 'open-ended' manner:

"Information Technology, which is having a profound effect on pupils whose adult lives will be in the 21st century, should find a place in all subjects which are able to take advantage of the facility to store and process information and to generate further information."

Information retrieval is the most available type of software to include the computer in a curriculum activity which involves information handling. Such activities were contained in both types of courses available to teachers, although all kinds of software were used on the Hamble College programme. This centralist (D.E.S) view of the

role of the computer within the curriculum has been incorporated into the county guidelines for the uses of microcomputers in primary schools, as discussed by County (1987), and implemented through their courses.

Chapter 9.

Conclusion

The case-study chapter of this research is a unique documentation of the introduction of an educational innovation over a period of five school terms. Such a case-study involving as it does the introduction of microcomputers into primary schools can never happen again. This evaluation is intended to bring together the complexities involved in this introductory period with particular reference to his original three aims described on page 4. These aims form the three subsections of the conclusion.

The organization and management of the introduction of microcomputers into four primary schools.

The^{researcher} investigated the organizational and management aspects of the introduction using the Schon Model. This model illuminated the methods employed by the schools and the L.E.A to supply hardware, finance and training to schools. Ultimately, the organization and management of the computer was involved with the deployment of hardware throughout the school.

One problem found by using the Schon Model was that it was developed as an economic model, not an educational one. This problem was faced by the researcher and found not to limit the study, because of the nature of the innovation - most key decisions taken by schools as a result of microcomputers were economic in nature and most problems faced occurred as a result of lack of financing

(i.e hardware, software, in-service training). Under these circumstances, the Schon Model provided a sound framework for the investigation.

A pattern emerged in the four schools with regard to the introduction of the computer hardware. A small number of teachers (in the case of Sunhill, one teacher) introduced the computer into the school. Gradually, other teachers became interested and the computer became 'in demand' and required for use throughout the school.

All four schools were to increase their range of hardware as the research progressed. However, this was, in three cases, through the purchase of peripheral equipment such as a disc drive, and not the purchase of an additional computer. Monkham was the exception to this, where the headmaster purchased a second computer towards the end of year one, with substantial finance from the Parent-Teacher Association which was available in this case but might not be in other schools.

The four schools were severely hampered by only having the resources outlined above. As teachers became more confident regarding the possible applications of microcomputers in the classroom, they began to exert pressure from within the school on teachers who were already using the computer, to obtain use of the computer equipment in their own classrooms. This was particularly the case at Middleton and Monkham. One consequence of this was that by the end of the research, no single class in any of the four schools was to have exclusive use of a

computer. This hardware limitation was to restrict the application within the classroom because teachers could not expect a continuity of computer usage, that is, sole use of a computer. It was often the case that teachers would use software which produced immediate results, software which was 'closed' in nature, rather than using more open-ended software, which was time consuming in terms of teacher familiarisation and application, and required the use of a computer as and when the need arose within a classroom topic. Keeble School (the largest), was the extreme case where teachers were able to use the computer one week in fourteen.

Another consequence of the limited hardware resources was that teachers would often make use of the computer equipment simply because it was their 'turn'. The result of this was that in such cases, the computer was not being linked to an existing classroom activity, but in a way which appeared to be isolated from the curriculum aims and objectives. In short, such activities were software driven and not curriculum driven. The D.E.S (1987), suggested that this is the case nationally, as discussed in chapter two.

Bleach (1986) reinforced the findings of the D.E.S. through the table of hardware resources illustrated in chapter two. The majority of schools still have just one computer.

The situation in the four schools taking part in this research was similar to those of the above survey. Monkham

was the only school to purchase a second computer.

Also, three of the four schools were to spend the first year of the research (the only year in the case of Keeble) using cassette recorders to load programs into the computer (disc drives were not supplied under the government scheme). Several teachers commented to the researcher that when they acquired a disc drive, then they tended to use a wider variety of programs, mainly because the process of loading a program from a disc drive is quicker and easier and thus more efficient. The most important issue this raises is that since the computer has its use within the classroom centred around the piece of software being used at that particular time, the lack of a disc drive has in some cases affected the range of software used with children. In short, it has affected the application of the computer within the curriculum. Efficiency has come before effectiveness. The initial offer of one microcomputer system to schools was a partial offer. Schools had to purchase disc drives and printers outside the government scheme.

The detailed application of the computer.

The second aim of the research was to investigate the uses made of the computer. This was closely linked to the third aim and involved the collection of data using triangulatory techniques. The researcher formed a complete picture of the situation through:

1. Participant observation in the classroom.
2. Discussions with teachers in various settings, e.g the

classroom, staffroom, Hamble College course.

3. Discussions with pupils.

One of the main advantages of using a triangulatory technique was that it enabled the researcher to gain insights into the practical implementation of an innovation through the many differing viewpoints given from the experiences of those involved. Ultimately, the research has historical value through its representation of a 'snapshot in time' of a particular situation in schools.

The greatest disadvantage of adopting this methodology was the mass of data generated through classroom observation sessions. The longitudinal nature of the research and the triangulatory nature of data collection necessitated this. However, he investigated the case-study through the development of the key decision flowchart illustrated on page 59. This flowchart provided a framework for data analysis since these decisions were common to all schools. This flowchart could provide a framework for future decisions schools will inevitably have to face when further hardware and software is required.

Having concluded the classroom observations after five terms, the researcher decided to focus on four key teachers to illuminate their thoughts, feelings and perceptions towards the computer and the software used, within the structure of repertory grids. This approach provided more data to enable him to complete the picture

of the detailed application of the computer.

The application of computers occurred through the use of particular computer programs. Teachers used various sources to find out what type of computer programs were available for use in schools. In the Hamble area, many teachers approached Hamble Technical College where there has been both an active in-service programme and opportunities to view software alone. However, it must be stated that this was quite a 'luxury' for teachers in the local area. Generally, teachers throughout the county would seek official county advice regarding applicable software, as would be expected since there are advisers in post to perform this function. They would not normally have somebody so near at hand to deal with their problems and enquiries.

A pattern emerged within the four schools with regard to the use of software. No teachers in the four schools had experience of using microcomputers in a classroom situation. As each school received its computer, then teachers began to introduce them into the classroom in an experimental way - that is, they were prepared to use various types of computer programs on a 'trial and error' basis. During the five term research period, much of software used was of the 'closed' type. This result is similar to Jackson's study, Jackson et al, (1986).

By the end of the research, one school had included the computer and particular computer programs in an official curricular document. The document included a breakdown of

the programs available in the school and how they could be used with children. The document related the software available to the existing curriculum. Two of the other three schools produced similar documents after the research had ceased. County were in a similar situation- the official county guidelines document for the uses of microcomputers in primary schools, as discussed in chapter two, was not produced until three years after schools had purchased their computers. This hampered schools considerably in the initial stages of the introduction of the computer system. Teachers were not given guidelines regarding the applications of the computer, they were in a position of 'finding their own way' when it came to using the computer in the classroom. It has been difficult to reach conclusions regarding the application of the computer since this research was conducted over only five terms, and the type of software used and the number of computers in use in schools is constantly changing.

It is clear that at the time of introduction, neither schools nor educational management (i.e, the advisory service, inspectors) were in a position to suggest how microcomputers could best be used. They simply did not know because they had not used them. The development of school and county based microcomputer policies occurred as software became available and could be related to their view of the primary school curriculum. The official county document contained examples of classroom practice and could not, therefore, have been produced at the time of the

introduction.

Schools rarely purchased software. Most of the material used came from the MICROPRIMER pack, county, or Hamble College. Many teachers in the four schools displayed the 'fashionable' element of education, as discussed by Young (1965). This involved teachers using a piece of software for a finite period of time and then progress to something else - the original piece of software being no longer useful. In terms of software, usefulness often refers to the teacher having seen other software which does the job better. This point was clearly made through the repertory grids. This aspect (of usefulness) can also be seen in other parts of education, for example, reading methods, intelligence testing.

The changing nature of the researcher's function during the introductory period.

The researcher has discussed the methods he employed to form an overall picture of the introductory period in the previous section. His interaction with teachers in the four schools was not just contained within the schools- he was also responsible for an in-service programme at Hamble College, which many teachers in the four schools attended. The development of the college programme occurred alongside his research in the four schools. His function on the courses was different from his function within the classroom since he was a course tutor/provider, as distinct from a participant observer in a school. Such a dual function enable him to provide a service for the

schools (just as they were providing a service for him). This reciprocal arrangement facilitated friendly relationships with teachers throughout the research.

The researcher conducted his in-service programme in a similar way to the introduction of the microcomputer into the classroom, by the classroom teacher. Initially he was not clear about the particular application of software in the classroom, he was simply concerned with giving teachers the opportunity to familiarize themselves with the available software. It was not until he observed many teachers using computers in many classrooms that he began to develop strategies on his courses to help teachers use software effectively.

The Hamble College courses introduced teachers to software. Teachers at the research schools often used software having initially seen it on such a course. These courses were more 'open-ended' than the courses instigated through county in that teachers were exposed to all kinds of software, and not just software which was county supported. Also, they were not selective- any teacher could attend.

The inspectorate and related advisory staff were the experts (as suggested through their positions in education) regarding the applications of software through the curriculum and chose software to use on courses which reflected their curriculum approach. They viewed the computer as a curriculum tool, and developed their curriculum perspective through the 'Leaders' courses. They

were consistent in their approach to extend 'good primary practice'. This point is illustrated in the letter sent to the researcher from the Senior Inspector for Computing, as illustrated in figure 12, page 126.

The researcher relied on the professionalism of teachers to make sense of the computer in their working environment and gave them the autonomy of choice in software. He made no attempt to develop a curriculum perspective - he had no authority or experience to do so. Ultimately, both approaches achieved a similar end - that of teachers using computers in the classroom.

Lampert (1985), discussed the two types of approaches to the introduction of microcomputers discussed above. She discussed the researcher's approach, which relied on a teacher's professional judgement to ensure that 'the job gets done', and the county approach which suggested that management view the profession as consisting of a group of people (teachers) who simply perform the act of disseminating other people's educational principles. Within this framework, teachers have technical not professional status. Before county produced their written guidelines document, the official view from the Inspector responsible for monitoring the introduction of microcomputers was that computers should be used in a way which displayed 'good primary practice' - an open-ended phrase which gave teachers encouragement to incorporate the computer into their daily work. Their written guidelines document suggested that the best use of the

computer is where it is integrated into the classroom as a teaching aid, usually through the use of 'open-ended' software. The document lists suitable software. In some cases, software contained in the county list was used, but in most, the software used was the material which was readily available to teachers, often 'closed' software. The county document, County (1987) made a brief reference to this type of software, suggesting that it should be used with care:

"Such programs should be viewed in the same light as text book exercises, and accordingly used with discrimination i.e. they should be selected with care to meet precisely the needs of individual children."

This emphasised the county view of the relevance of the computer to the curriculum and makes no reference to resourcing available, teacher confidence, and ease of use of software.

'Open-ended' software tended to be used by teachers who felt confident to use it. The county perspective reflected in the document, incorporated the brief reference made to information technology by the D.E.S document The Curriculum 5 to 16, D.E.S (1985), that of the part to be played by information retrieval and data handling. The L.E.A reinforced the centralist policy in which teachers are expected to deliver education to their pupils, and are part of a service industry.

The main problem faced by the researched schools (and indeed many other schools known to the researcher) was using the computer in an 'open-ended' way with the limited

hardware resources available. Three of the four schools had one computer system. All teachers in the four schools had restricted, not exclusive use of the computer. The county curriculum document was developed within a framework of 'open-ended' software. This raises the important issue of a teachers' ability to implement the curriculum guidelines developed by county. The researcher's experiences through both school visits and his in-service programme have indicated that many schools operate within a framework of restricted use of the computer - often 'closed' software is used, where children get immediate results. In this situation, there is no continuity of computer usage. Where 'open-ended' software was used by teachers in this study, it was often after attendance on a Hamble College in-service course or software guidance from the researcher in a classroom setting. Both these facilities illustrate the consultative nature of the study, and were not available to schools outside the area.

There is no doubt that the schools taking part in the research benefitted from having the attention of the researcher in the many ways discussed throughout this thesis. He was a type of 'private consultant', another resource element to the schools through his research. His position was one of researcher and in-service provider and not a primary expert- that position was obviously adopted by county. Their approach to the introduction of microcomputers in primary schools was concerned with aims

and objectives and not provisions and resources. Conversely, the researcher was not initially concerned about an overall curriculum policy, simply making teachers familiar with software. This approach enabled teachers to use the computer in the classroom. It is only now, two years after the research period, that teachers are beginning to review their use of the computer and ask themselves questions regarding the curriculum implications for using particular software. These questions are retrospective, and are present because of an increase, (albeit gradual), of the amount of hardware being purchased by schools. It is possible that the county approach was more of a long term plan than the researcher's, who was initially concerned not to alienate teachers by suggesting the use of open-ended software which was not practical with the resourcing available.

Further Research.

Chapter two discussed research which has been conducted into the application of particular software. This study has illuminated areas for future consideration. One of the most important issues raised in this thesis is the use teachers make of software with the limited hardware resources available. There is a mismatch between the applications of the computer, based on ideal hardware conditions and research, and the reality of the classroom with sparse resourcing. Research is needed to find out how the application of particular software occurs under typical classroom conditions - that is, where a classroom

teacher does not have exclusive use of a microcomputer. Such research is particularly needed with regard to 'open-ended' software, which has often been researched within an environment of plentiful hardware resources, often in laboratory type conditions.

Also, little is known about the reasons designers of software use particular language and screen displays in their computer programs. For example, information retrieval is a computer activity which is facilitated by a computer program. There are many information retrieval packages available which achieve varying degrees of success, as discovered by the researcher during his in-service programme. Research is needed into the design of such packages so as to achieve optimum application in the classroom, with the resourcing constraints.

Finally, this research has exposed a particular issue which is not solely related to educational computing - the autonomy teachers have as practitioners. The researcher has outlined the two approaches to in-service training adopted by himself and county. Do teachers have autonomy regarding the applications of an innovation, or are they seen by management as either good or bad technicians, the workforce of a delivery system? Such questions have been illustrated in this thesis with particular respect to the introduction of an innovation.

One point is clear from this research - the introduction of an educational innovation should be accompanied by substantial in-service training at the time

of introduction. In the case of microcomputers, teachers were not aware of classroom applications of the computer. The four schools (and all others in the Hamble area known to the researcher) made the decision to buy microcomputers with no knowledge of the possible applications in the classroom. It could be argued that the acceptance of such an offer confirms the management view of teachers as technicians, and not professionals. Management simply expect teachers to disseminate knowledge according to their 'rules'. This study has shown that teachers do not always adhere to county guidelines (i.e the rules). What actually occurs in the classroom is often not the translation of county objectives into practical work, but a practical application of the computer, through software, in a way which reflects the resourcing available to that particular teacher.

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Appendix 1.

Glossary of terms used in the research.

Closed Software.

Software which has definite aims and boundaries.

Mathematics software tends to be like this, where a particular mathematical concept is being developed, for example, angular work. This type of software is said by the researcher to be 'software driven'.

Curriculum Driven Activity.

A computer activity which has occurred as a result of a classroom project. For example, the use of Information Retrieval to classify information regarding a classroom project on dragons.

Ethnographic Research.

Small-scale research where the researcher participates in a particular setting in order to make sense of it. Closely linked to illuminative research.

Hardware.

The physical components of the computer such as the keyboard, monitor, disc drive.

Illuminative Research.

Research which exposes intricate educational processes within a particular educational setting. For example, case-study research within a classroom often exposes the sense teachers make of the educational process through their pedagogical approach, and is therefore illuminative in nature.

Information Retrieval.

A computer activity which involves the use of a computer program to classify information regarding a particular classroom topic. Once classified, it can then be extracted from the computer through an interrogation.

Logo.

A computer programming language designed specifically for young children by Seymour Papert.

M.E.P.

Microelectronics Education Programme. A body set up with the aim of supplying educational computer programs to school.

Microcomputer System.

The hardware which constitutes the material supplied to primary schools. Most schools recieved a monitor, keyboard, cassette recorder, and later, a disc drive, and in some cases, a printer.

Microprimer.

Software supplied to all primary schools taking part in the 'Micros in Schools' scheme.

Micros in Schools Scheme.

The government scheme which supplied 50% of the cost of one microcomputer system to primary schools.

Open Software.

Software which is without particular content. For example, An Information Retrieval program, which relies on information regarding a particular classroom topic. This type of computer activity is said by the researcher to be 'curriculum based'.

Software.

The programs which enable the hardware to work in a particular way.

Software Driven Activity.

A computer activity which has occurred as a result of a computer program. For example, the use of a drill and practice program.

Word Processor.

A computer program which enables the computer to be used as a text storage device. Having typed in text, it can be conveniently saved on disc for future use, or printed out. This thesis has been produced on a word processor.

Appendix 2.

Repertory grids.

Mrs Harris.

The raw grid culminating from the elements and constructs elicited from Mrs Harris was as follows:

	1	2	3	4	5	6	7	8
a	1	5	5	4	5	2	2	3
b	5	5	5	5	1	1	5	4
c	2	5	3	5	5	5	2	3
d	1	5	5	1	5	5	1	1
e	5	5	3	5	1	1	4	4
f	5	5	1	5	1	3	3	3
g	1	1	5	1	5	4	0	0

Simple visual analysis was undertaken by the researcher using the following techniques:

- 1. Visual / hand focusing.
- 2. Arithmetic sum of differences matrix.

Both techniques are discussed by Pope and Keen. (1981), and provide a pattern of relationships between elements and constructs. The first stage is to produce a matrix containing the sums of differences of each column of elements. Mrs Harris' matrix was as follows:

Sums of Differences of Elements.

	1	2	3	4	5	6	7	8
1		11	19	22	27	21	5	8
2			12	5	16	16	14	13
3				17	8	14	16	15
4					21	19	9	8
5						6	24	26
6							18	17
7								3
8								

This matrix illustrates the close relationship of elements seven and eight, two and four, one and seven, one and eight, and three and five. This close relationship

provided the framework for the re-ordering of the columns, (i.e. elements), to initiate clustering, as illustrated in the diagram below:

Elements reordered in a rated grid.

	2	4	3	5	6	7	8	1
a	5	4	5	5	2	2	3	1
b	5	5	5	1	1	5	4	5
c	5	5	3	5	5	2	3	2
d	5	1	5	5	5	1	1	1
e	5	5	3	1	1	4	4	5
f	5	5	1	1	3	3	3	5
g	1	1	5	5	4	0	0	1

Having performed clustering on the elements of the grid, the researcher then concentrated on the constructs in a similar way. The following matrix illustrates the sums of differences of the constructs:

Sums of differences of constructs.

	a	b	c	d	e	f	g
a		14	7	9	15	15	14
b			17	23	3	9	28
c				10	14	12	17
d					24	22	7
e						6	29
f							27
g							

This matrix illustrates the close relationship between constructs b and e, e and f, a and c, d and g, and b and f. Clustering these close constructs together produced the final focused repertory grid:

Constructs b and c, and d and e are closely related. The final focused repertory grid was as follows:

				d	l	a	
			r	a	r	y	
			a	c	e	g	h
			g	i	m	o	t
		s	t	i	l	i	
	y	a	p	r	e	w	
n	e	o	a	s			
n	h	r	h	d			
a	t	c	c	t	d		
r	a	i	r	a	o		
g	m	m	a	m	p		
	1	2	6	4	5	3	
user friendly	-	3	5	5	0	2	- not user friendly
generates interest	-	3	4	5	1	1	3- immediate use only
graphic interest	-	2	4	4	3	2	1- no graphic interest
needs teacher	-	4	4	3	2	3	4- teacher not needed
sustains interest	-	2	2	3	1	4	4- unsustained interest

Mr Thomas.

His raw grid was as follows:

	1	2	3	4	5	6
a	2	1	5	5	4	4
b	2	4	1	1	1	1
c	1	2	3	0	3	0
d	3	2	5	5	5	5
e	4	4	1	1	2	4
f	4	1	5	5	5	5

With sums of differences of columns of elements as follows:

Sums of differences of elements.

	1	2	3	4	5	6
1		8	12	11	10	7
2			19	19	16	15
3				3	2	7
4					5	4
5						5
6						

The matrix illustrates the close relationship between elements three four five and six. The sums of differences

Sums of differences of constructs.

	a	b	c	d	e	f
a		17	14	4	15	4
b			9	19	6	21
c				16	13	18
d					15	2
e						15
f						

		d	a	r	t	d	y	f	w	n	s	e	c	p	r	o	s	s	d	r	d
				/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/
		d	w	t	r	a	c	h	g	a	r	n	y	i	f	l	e	u	s	e	a
		6	4	3	5	1	2														
decision making	-	0	0	3	3	1	2-	non decision making													
user in control	-	1	1	1	1	2	4-	user not in control													
pupil controlled	-	4	1	1	2	4	4-	program controlled													
random	-	5	5	5	5	3	2-	positive													
irrelevant	-	5	5	5	5	4	1-	relevant													
adventure program	-	4	5	5	5	2	1-	non adventure prog.													

His raw grid was as follows:

	1	2	3	4	5	6	7
a	5	1	1	4	2	1	5
b	3	2	3	2	2	5	4
c	3	1	5	4	1	5	4
d	5	1	3	1	4	5	5
e	5	1	4	3	3	5	5

a 8

	1	2	3	4	5	6	7
1		15	9	9	9	8	2
2			10	8	6	15	17
3				8	8	5	9
4					8	13	9
5						11	11
6							6
7							

Elements one and seven and three and six are closely related. The sums of differences of constructs matrix is as follows:

	a	b	c	d	e
a		12	12	11	9
b			6	7	7
c				11	7
d					4
e					

Constructs b and c, and d and e are closely related. The final focused repertory grid was as follows:

[illegible]